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Fires Caused by Electricity. IT is a much easier thing to make the assertion that a recent fire in Utica was caused by a telephone wire some 30 miles distant than to prove that it was not so caused. A few fires are known to have been caused by rats taking matches into their nests and trying to eat them there. We defy any one to prove that this fire was not caused in this way; and as they cannot prove the contrary, we have an equal right to say that this fire was caused by rats. There was electricity in the building, so were matches and rats.

The Trolley and High-Tension Arc Currents. IF lines of 3,000 volts used for arc lighting, and of 1,000 volts used for alternating current distribution, have not been found dangerous enough to raise insurance rates for a whole city, then why should a trolley wire of only 500 volts be such a serious matter? To be sure the latter wire is bare and the other pole is earthed, but the insulation on the other circuits is little protection against a broken telephone or telegraph wire which crosses it and soon saws through the very best insulating material that could be made.

Rapid Transit and Electric Traction. AS the subject of rapid transit has been the absorbing one in New York during the past week, we give in another place a review of the situation as it exists at the time of going to press, together with the views of two of our leading electricians on this most vital question. So closely allied with rapid transit as to be almost synonymous with it, is the subject of electrical traction. To these two subjects we give a large portion of our space this week, so much, indeed, as to make this number deserving the title of The Rapid Transit Number.

The Congress. THE British World's Fair Commission make some suggestions which we publish elsewhere, regarding the coming Congress. While suggestions are always welcome, it is with regret that we notice the almost complete absence of any recommendations regarding the introduction of the badly needed units, among the chief of which are the magnetic units. It was hoped that the English, who have done such good work in this field, would assist Americans in endeavoring to standardize magnetic units, before the need for them will become so great that different nations and private parties will break the excellent uniformity in our other units by introducing different units and different names in the various countries for measuring magnetic quantities.

Alternators in Parallel. THOSE who still think it is not practicable to run alternators in parallel would do well to read the description published in another column of how it is done daily in the city of Cologne. Perhaps it will be argued that the apparatus is complicated, but that is a poor argument in cases such as this, where a complication really means reliability. Too much stress is often put on the supposed evils of complicated machinery, but it should not be overlooked that a slight complication which prevents any possibility of the attendants making a mistake is often much better than to trust to a human machine. Interlocking signal systems, for instance, are complicated, sometimes very much so, but the cost of their construction and maintenance has doubtless been saved many times over by rendering costly and fatal mistakes impossible.

The Philadelphia Trolley Road. THE recent final decision of the courts, which opens the streets of Philadelphia to the trolley, concerned a legal technicality and not the virtues of the trolley. It is a great triumph for the electrical system, as this project embraces the largest mileage of streets in any one city on which changes from horses to electricity are contemplated in one sweep. With its 500 miles of street railways, Philadelphia heads the lists of cities of the entire world in this feature, being seconded by Chicago. Most of its roads are owned by the company who succeeded in getting the valuable trolley privileges. The change from horses to trolley, it is estimated, will make a difference of millions of dollars every year in the net profits to the company. Some idea of the size of the undertaking may be had from the fact that at least 10,000 poles will be required to equip the lines at present contemplated, and it can hardly be doubted that this change will soon be followed by a similar one in all of the other roads of the city.

Reorganization of the Fool Killer's Office Needed. WE have not been intrusted with an intimate knowledge of the organization of the fool killer's office, but it is apparent from the outside that the active force should be largely increased. When the chief killer is in Boston, Chicago and the West suffer, and when matters get so bad there as to require his personal attention, his quarry bobs up in Boston. The operations of primary battery Pennock and airship Pennington in or near Chicago, of recent memory, rendered the presence of the great executioner in those parts imperative, with the result that Pennington is for a time silent, and Pennock has changed his voting place to Boston, recalling the case of the agile flea, which "now you see, and now you don't." *The Financial and Commercial News*, of the latter city, in its issue for Dec. 29, speaking for Pennock, devotes the first column of the front page to the announcement of a wonderful invention of which Pennock of course, is the hero. In scare headlines it speaks as follows: "A Great Problem Solved," "Marvelous Revolution in Electrical Science," "Something Out of Nothing," "The Pennock System Causing the Dynamo Electricians to Hedge," "1,000 H. P. as Cheap as One Horse Power,' "Thousands Seeking to Invest." Then, in brevier type, after characterizing Pennock as the Moses of the electrical wilderness, it makes, among others, the following startling announcements: "Mr. Pennock delivers 1 h. p. to his voltage distributor and takes out 1,000 h. p. without any additional expense." He lights one 20 c. p. lamp and then turns on 5,000 additional ones without increase of cost, which is placed at five cents per hour for the lot. No wonder, then, that "the principal ones of such great companies as the Thomson-Houston and Edison *freely admit* that Pennock's invention completely knocks them out." It characterizes Pennock's invention as more important "than the Bell telephone or any other within the past century," and states that it "has no competitor, and is not likely to have, unless some genius shall rise up and cheapen daylight and the wind." "As an investment security we shall never again, in all probability, know anything to at all approach the shares of the Pennock, *and now is the time to subscribe.*" (The italics are ours.) The startling article concludes with the following disinterested editorial (?) indorsements: "If you are any way incredulous concerning our assertions, which are made solely for the benefit of our readers, then investigate for yourself, and if you are not convinced of their truth *we are willing that our reputation should suffer.*" (Italics again ours.) This is pretty good for the primary battery and Keeley must look to his laurels. Munchausen, too, must have turned in his grave at the thought of a wasted life, rendered futile by one fell stroke as those lines were penned. We submit that the fool killer is badly needed in Boston just now.

The Conductivity of Insulating Bodies. THE effect of the physical condition of substances upon their dielectric properties is one that is deserving of more study than it seems to have received. In another column we reproduce from the *Philosopical Magazine* a portion of a paper on this subject by M. Edward Branley, M. D., in which he calls attention to the fact that very thin fibres of insulating bodies seem to become conducting, and that good conducting material opposes great resistance to the passage of a current when inserted in its path in a pulverulent condition. Thus far there is nothing in his statements that might not have been arrived at by *a priori* reasoning; but that the conductivity of the pulverulent mass may be measurably restored by the discharge of a Leyden jar in the vicinity and destroyed again by a slight mechanical shock, while not new, could scarcely have been anticipated by theory. The phenomena having been demonstrated, however, one or two theories at once suggest themselves as plausible explanations of their cause. There are one or two other phenomena of thin fibres or pulverulent dielectrics, however, whose explanation is not so obvious. For instance, if the two ends of a circuit be varnished with shellac, and after the latter is thoroughly dry be brought into intimate contact, the insulation against low potentials is practically perfect. But place this junction in an atmosphere of pure hydrogen gas, the resistance is gradually lowered until comparatively good conductivity is established, only to be destroyed again equally gradually when the hydrogen is removed. Neither mechanical shocks nor moderate increase of temperature seem to have any perceptible effect upon the rise or subsidence of conductivity. But if the treatment with hydrogen be repeated after complete resumption of the insulating state in air, the junction cannot be restored to the same degree of conductivity it was made to assume in the first instance, and the effect of the hydrogen gradually decreases with each subsequent application, until it seems to disappear entirely. Carbonic oxide and artificial marsh gas produce the same effect, though to a less degree, while natural marsh gas seems to be inert. The presence of carbonic acid, nitrogen, oxygen or other electro-negative gases, even in considerable proportion with the hydrogen, seem to have no effect upon the phenomena except what might be reasonably attributable to the dilution caused by their presence. On the other hand, if finely pulverized hard glass be imbedded in the two ends of the circuit and they be brought together again as before, and hydrogen applied, a much higher conductivity will be attained than in the case where shellac was the dielectric, but it will not be assumed gradually a before, but in a series of impulses each succeeded by a non-conducting state, these electric impulses becoming more and more frequent until the current finally passes continuously with nearly the same freedom as it would were the conductor unbroken. On removing the hydrogen, the junction remains conducting much longer than where shellac is used, but loses its conductivity completely and instantaneously. Thus many substances have been tried with similar results, but differing in degree. But the manner of assuming conductivity and of losing it again seems to differ with each, and to be in a measure characteristic of the substance employed. A satisfactory explanation of these phenomena has not yet been suggested.

Rapid Transit.

At high noon of Thursday, Dec. 29, 1892, there was put up at auction the right, privilege and franchise to construct, maintain and operate for a period of 999 years the railway under Broadway and other streets in the city of New York, as laid out and determined by the Board of Rapid Transit Railroad Commissioners for the city of New York, according to terms of sale formulated by that same august body. How the franchise went begging, there being but a single bid of $1,000 offered, is known to all, a mystery to many, and the reason thereof understood by few.

That the careful work of five conscientious business men for many months, under the advice of the ablest engineers of modern times, and in a direction which the logic of the times has demonstrated to be imperative, should come to this most ignominious end has been deplored by all, but that the commission itself, certain of its ground from an engineering standpoint, should consider the project a failure, and its own work impracticable, seems almost inexplicable. If the engineering questions had been satisfactorily settled, as is maintained, the fault must lie with the terms of sale. These the commissioners reserved the right to modify as expressly stated in section 17, which reads "The Board of Rapid Transit Railroad Commissioners reserves to itself the right to reject all bids and readvertise the said rights, privileges and franchises for sale under the same or *different* terms of sale, as often as it may deem necessary in the interest of the city of New York," etc.

Why then, when it was demonstrated that the terms of sale were such as to forbid the investment of capital, the commission should stultify itself and its own work, as it has by declaring the whole thing, itself included, a failure, instead of readvertising on terms that would attract capital, is one of the things that it is hard to explain.

With the example of the Metropolitan Underground Electric Railroad in London before us, carrying 125,000,000 persons annually where each inhabitant averages but 183 journeys a year, there would seem to be no question of a similar franchise in New York, whose population averages 243 trips per head per annum (*Engineering News*, Oct. 31, 1891), were not that franchise hedged about by prohibitive restrictions and conditions which it is clear the commission reserved the right to remove.

A writer in a recent number of the London *Quarterly Review* (supposed to be Mr. W. M. Ackworth, the well-known English writer on railway affairs) points out the need of increased facilities for urban traffic in London, and shows that this need can be met by the construction of additional underground electric railways, several of which are already proposed. But he also fears that the present tendency of the city and government authorities to impose more and more onerous conditions may result in preventing capitalists from providing the funds necessary for the carrying out of the work. The fears thus expressed have been fully realized here, and what is inexplicable is that no attempt has been made to apply the remedy when the most obvious remedy was at hand.

That the result obtained under the conditions imposed was no better than should have been expected, and therefore should have been guarded against, is evident from an analysis made by our esteemed contemporary, *Engineering News*, and given in its issue of Nov. 24, 1892. This is so convincing that the wonder is, not that more favorable bids were not received, but that *any* bids were received. We quote:

"Time will prove that either there will be no bidder for the franchise (which is highly probable), or that it will be knocked down for some paltry sum without competition." How prophetic!

In fact, as the law under which the commission acts makes no provisions for paying it anything except a lump sum for its service in "locating" the lines, to be fixed by the courts and paid by the bidder before construction begins, it looks as if the commission might pass into innocuous desuetude, if not out of existence, before construction is fairly started.

In the first place, of the many possible ways of securing compensation to the city, the commission has selected the worst—cash down in advance. This is the one thing of all others that those undertaking a speculative enterprise, requiring an enormous investment at best, object to most, as most burdening the enterprise. They much prefer, and can much better afford, to give a large contingent interest. Thus the private individual with an enterprise to float who wants to sell for cash what has cost him nothing, and then to get out, stamps himself as a fraud at once. In addition to the obligation to raise $60,000,000 to $70,000,000 for construction, several millions of which must be on hand in cash before the work is started, the bidder is obliged by the terms of sale to pay in at once or put at risk:

1. Ten per cent. of the amount bid (at sale), say 10 cents, to	$100,000
2. Guarantee deposit (at sale)	1,000,000
3. Ninety per cent. of the amount bid (in 30 days), say 90 cents, to	900,000
4. Back expenses of commission (in 30 days), say	89,247
5. Current expenses of commission (in 30 days), say	30,000
6. Compensation expenses of commission (in 30 days), say	50,000
7. Security bond (in four months)	2,000,000
8. State tax on stock (one-eighth per cent.)	62,500
9. Initiatory expenses of bidder, say	100,000
Total	$4,331,747

By the time that construction is fairly under way the amount at risk will be nearly double this; all of which the bidder stands to lose if things should go seriously wrong in any way, a chance which every bidder figures on as possible. . . . The private investor is not going to touch a politically controlled franchise unless he thinks he sees 8 to 10 per cent. in it for him at least. At these rates, the present worth to bidders of the surrender of their $100,000,000 investment at the end of various periods up to 200 years (will not go further) would be as follows:

Present worth of $100,000,000.	At 8 per cent.	At 10 per cent.
At end of 50 years	$4,689,420	$851,854
At end of 100 years	45,459	7,257
At end of 200 years	($20.67) 21	(52.6 cents.!)

How wicked and silly seems the sacrifice of the city's interests by the terms of sale in the light of this showing! By presenting to the possible bidder what he will only value (if he be a well posted business man) at 53 cents in cash, the commission propose to deprive the city of the ownership of $100,000,000 worth of highly lucrative property for 999 years; nay, forever! For the property is nots even at the end of 999 years, to revert to the city. But the sacrifice is even greater than this. No business man will pay $1 cash for an interest which is only worth $1 now and does not mature for 50 years. Therefore, every *bona fide* bidder at the sale, if there should chance to be one, would greatly prefer to surrender the whole property to the city at the end of 50 years than to pay even $851,854 cash down for the franchise; and surely the commission do not expect to sell it for less than that.

Let us for curiosity sound the full depths of the 999 year folly. The present value of $100,000,000 at the end of 999 years (not $1, but $100,000,000, be it noted) is as follows at various low rates of interest:

At 3%, $0.00,001,5
At 4%, 0.00,000,000,096
At 5%, 0.00,000,000,000,006,8
At 6%, 0.00,000,000,000,000,000,190,8

The comma enables one to read readily what the present value of this sum is in cents. In other words, we can at 6 per cent. put 1 cent to-day at compound interest until it amounts to $100,000,000; throw it all away except 1 cent; keep that at compound interest until it is $100,000,000; throw all that away again but 1 cent; put that again at compound interest, and at the end of our 999 year we shall be more than half way toward a third $100,000,000, which we may well believe will be useful to the city even 999 years from now, for the city is likely to still exist, and perhaps be much poorer than now!

After the inevitable results of the terms of sale had been realized a meeting of those vitally interested in rapid transit was held at the Real Estate Exchange to devise ways and means out of the dilemma. This was on Jan. 5. A set of resolutions were then declared passed in favor of asking the city to build the underground road herself. But there was a large number who dissented from these views, and who claimed that they had been counted out by the chairman. These, immediately upon adjournment, called another meeting on the spot. Excitement grew apace and crimination followed crimination until something of the nature of a Donnybrook fair seemed imminent. Finally upon order being measurably restored, a sub-committee was appointed by the dissenters to draw up and present to the commissioners a set of resolutions adverse to the municipal scheme, and favoring the extensive of the present elevated railroad system.

These two committees appeared in open meeting on Friday last, before the Commissioners, each claiming to represent fairly the real estate interests, and each denying that the other did so represent them. One faction argued that the city should undertake the underground system, and the other that that plan should be abandoned as impractical and that the elevated system should be extended. But no action has yet been taken.

Some of the daily papers and many of the public look upon the whole thing as a fight between two interests, viz., Tammany and the Manhattan Railway Company, and some are so uncharitable as to state their belief that the terms of sale were purposely made prohibitive with the view of advancing either one or the other interest, and that it was never the intention that private capital should take hold of the enterprise. It may not be so generally known outside as it is in New York, that its people look with suspicion upon enterprises controlled by the politicians and the extension of the elevated system alike, but the feeling is certainly very strong.

Whether or not the whole scheme has been manipulated in favor of the Manhattan company, those who maintain that it was, point to the movements of stocks of the latter as confirmatory of their position. Beginning with Dec. 19 at 132½, Manhattan sold up to 155½ on Jan. 7, being an average rise of two points a day for every day intervening.

A third course which seems the most likely to be a solution of the problem is that proposed by ex-Mayor Abram S. Hewitt, who by the way was placed on both committees, but acted with neither. Having been misquoted by most of the daily papers he sets himself right as follows, in a letter to the *Evening Post* of Jan. 6. He says:

(1.) I reiterate my belief in the wisdom of the plan formulated in my message sent to the Common Council in January, 1888. This plan proposed that the city should own the rapid transit system and pay for it by an issue of 8 per cent. bonds.

(2.) The construction was, however, not to be intrusted to the city officials, nor to any State or municipal commission. It was to be built by a corporation, leasing the system at 5 per cent. on its actual cost, which, as a matter of course, would thus be reduced to the lowest possible figures.

(3.) The difference in the rate of interest on the city bonds issued to cover the cost, and the rate of rental received under the lease, 3 per cent. per annum, would by a sinking fund discharge the principal of the bonds in 35 years, when the city would own a magnificent property without any cost whatever to the taxpayers."

This looks like a business proposition, as involving neither monopoly nor politics, and while accomplishing for its inhabitants the necessary relief in true rapid transit, permits the investment of private capital while still retaining for the city a property of inestimable value.

Electricians everywhere have watched the progress of this undertaking with extreme interest, as the specifications state that "The cars must be propelled by electricity or by some form of power not requiring combustion," and its apparent collapse or failure has been a deep disappointment to all. Its successful accomplishment, should it be undertaken, was doubted by none, and would mark an important epoch in electrical traction. The application of electricity to the elevated roads would be hailed with no less pleasure by laymen and electricians, but the inertia of the Manhattan company gives little promise of its immediate adoption.

Mr. Franklin L. Pope entertains the following views upon the subject: "The conditions of the franchise were such that it could hardly have been expected that a purchaser would be found. The fact that such a large amount was required to be deposited, before taking any steps to carry out the enterprise, was alone sufficient to prevent capitalists from looking with favor upon the scheme. Then the time limit which was imposed upon the purchasers of the franchise was another serious obstacle. With the unforeseen difficulties which the construction of such a tunnel under New York City must necessarily involve, it is evident that no contractor could safely guarantee the completion within so short a length of time. Unexpected obstacles would surely be encountered, and every one who has had any experience in such work knows that delays are inevitable. It certainly seems as if the Rapid Transit Commissioners might have made the conditions of the franchise much easier to the undertakers, while at the same time amply protecting the interests of the public. It might at first sight appear as if the terms had purposely been made in such a way that, in all probability, no purchaser would be found.

"In reference to the future of rapid transit in New York City, I do not believe that any elevated system can be devised which will meet the requirements of the rapidly increasing travel. A little calculation will show that at least two four-track lines would be required. One four-track line would not more than suffice to transport comfortably and quickly the passengers which daily travel to and fro at the present time, while in the course of 20 years, and more probably 10, this number will undoubtedly be doubled. The most feasible scheme in my opinion is that of a deep tunnel system, and no satisfactory reason has ever been put forward by the Rapid Transit Commission why such a system would not prove feasible and sufficient. With the present improved methods of tunnel construction it would be much easier and far less expensive to build a tunnel 100 feet under the surface than 20, and at that depth there would be no difficulty or expense in reference to the right of way, and no heavy damages to be paid for injury to private property. Elevators could carry the passengers to the surface much more quickly than they are now able to climb long flights of narrow and crowded stairs to reach the stations of the Manhattan Elevated Railroad. The whole system, including the elevators, could be operated by electricity from two or three central stations placed at convenient points along the route. A very important advantage of this scheme would be that the existing steam railroads could connect directly with it, branch lines being run from the tunnel to New Jersey, Long Island and other points. The railroads could then run local trains of their own, making a circuit around the city for picking up and transporting passengers to their depots. To illustrate, the Pennsylvania Railroad might send a train down through the tunnel on one side of the city and up the other, gathering the passengers from all along the line, carrying them to its main station in Jersey City, and there transfer them to their respective trains. Such an arrangement would certainly be a great convenience and be appreciated by the vast numbers of people who are now obliged to make one or more transfers and cross a ferry to reach the railroad stations.

"The deep tunnel system is a subject upon which I have bestowed considerable attention, and it seems to me that such a plan is not only perfectly practicable, but is the only one which is likely to be adopted in the future. If the franchise for a deep tunnel system was offered to the public under reasonable restrictions, there is little doubt in my mind that capitalists would be found ready and willing to undertake the construction of such a road."

Mr. H. Ward Leonard made the following statement in reference to the rapid transit franchise: "The chief reason why the rapid transit franchise was not sold is probably that capitalists hesitate to invest their money in an enterprise which comes in direct competition with the present elevated railway system. The low first cost of the elevated roads and the great cost of the underground system would naturally prevent capitalists from taking up such a scheme, unless a large traffic were assured. It is possible that the terms of the franchise, as offered, were unnecessarily severe, but that alone would not be sufficient to prevent the construction of such a road provided a fair profit was assured. It is argued that the advantages of an underground system, especially the higher rates of speed which would be attained, would be sufficient to take much of the present traffic from the elvated roads and to attract a sufficiently large number from other lines to insure a profitable investment. But it may be said in reply to this that

as soon as a competitor enters the field the elevated railroad system will be greatly improved and the number and speed of express trains materially increased. Moreover, the chief objection to the elevated roads at the present time is the fact that they are over-crowded and it is usually necessary for passengers to stand. If the system was relieved of a portion of this heavy traffic by an underground road, this objection would vanish, and many who do not now care to travel on the elevated trains would then do so, so that the tendency would always be toward a heavy traffic there in preference to a tunnel system.

"The Rapid Transit Commissioners were right in specifying that the tunnel should be constructed as near as possible to the surface. The question of transferring passengers from the ground to the trains in the tunnel is a serious one, and would involve great difficulty if a tunnel was placed far below the surface. In such a system it is proposed to make use of elevators, but a little consideration will show that this is quite impracticable. In the present elevated system the great mass of passengers take the trains in the evening at two or three stations, comparatively few getting on at other points along the route, and in an underground system, where the express service is more extended, the tendency would be still greater in this direction. Often at one station a sufficient number are waiting to more than fill a train of five cars, and there is nowhere in the world an elevator or system of elevators which can transfer this number of people without making a number of trips. When the passengers are anxious to catch a train they would certainly be unwilling to wait until an elevator had made several trips, and the result would be that the jamming and crowding into the elevators would be even worse than it is now at the elevated stations. The passengers would probably rush down stairs instead of taking the elevators, and as the distance would be much greater than from the surface to the present elevated structures, this would prove very objectionable. Theoretically, the transportation of all the passengers by elevators is an excellent plan, but in practice it will be found to be far from satisfactory.

"It seems to me that the only solution of the question is for the city to become interested in the construction of an underground system and pay a bonus or subsidy to such capitalists as would undertake its construction. For example, the city might guarantee a dividend of 4 per cent. at first, until such time as the enterprise yielded a profit equal to that amount, and the payment of any deficit would be a good one, considered from the point of view of the citizen and taxpayer. Even if the road should never prove profitable it would still be a wise investment and for the public good.

"It is evident that private capital will not undertake the construction of an underground tunnel system, involving such a vast expenditure of money, so long as it is obliged to enter into competition with the elevated roads; and unless the city takes the matter up the question of rapid transit will be given over to the present elevated railroad system, and just so long as the Manhattan Elevated Railroad has no competitor it will continue to give a service which is unsatisfactory in many respects."

The Rock Creek Electric Railway, Washington, D. C.

BY F. G. BOLLES.

HISTORICAL.

It is but natural for one to expect to find every modern convenience in the capital city of a nation so prosperous as ours, but, with the exception of the last four years, a lack of enterprise has been a prominent feature of Washington.

It is true that the city has been planned upon an elaborate scale, and one cannot help but admire the broad streets and avenues, which have gained for it the popular name of "the city of magnificent distances." The city has made a great stride in one direction, namely, the paving of the streets, and in this respect it stands in the front rank. But for a truly modern city, which it should be in every respect, that it might properly represent the nation's prosperity, many other improvements were necessary. The most important of these were rapid transit and suburban homes. Until the year 1888 no move had been made which was of any importance. There existed three or four horse car lines, whose tracks barely extended to the outskirts of the city, and their antiquated equipment, in which the one-horse "bobtail" car played a prominent part, would hardly have been tolerated in any other city of its size in the country.

But the scene is rapidly changing. Washington is beginning to assume an air of prosperity, and at the present rate another decade will have so changed things that the city will fairly represent American enterprise.

Capitalists at last realize that there existed here opportunities for investment that should be taken advantage of. In evidence that this has been done, it is only necessary to point to the many new and beautiful subdivisions, which, since the time above stated, have been, and are now being, platted and put upon the market.

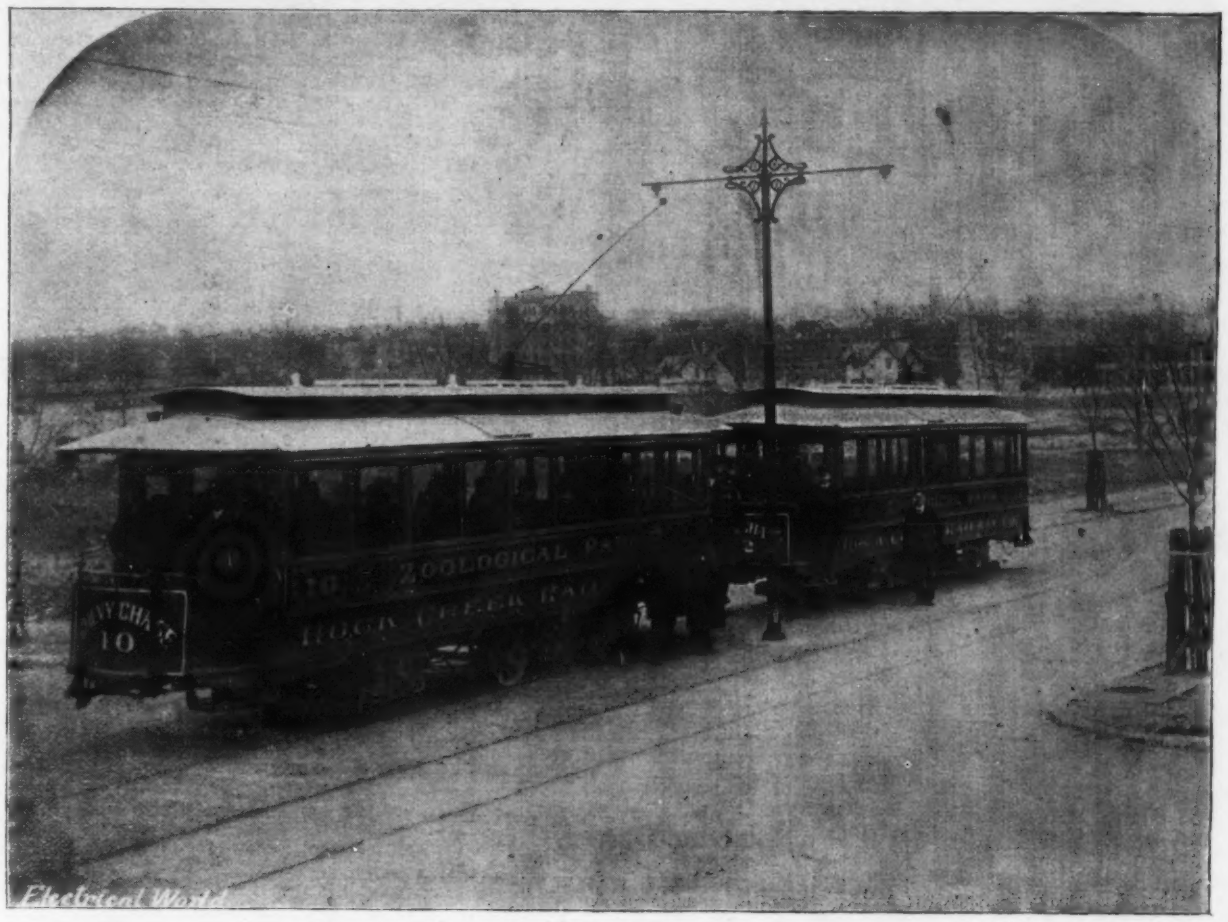


FIG. 1.—ROCK CREEK RAILWAY—CITY TERMINUS.

One of the first substantial moves in this direction was the platting of the sub-division, known as Eckington, and the building of the Eckington & Soldiers' Home Electric Railway.

Following this was the Georgetown & Tennallytown Electric Railway, and in rapid succession the Glen Echo Electric Railway, by which is reached the beautiful Glen Echo Chautauqua, situated upon the Potomac, some seven miles northwest from the city; the Rock Creek Electric Railway, a description of which will be given; the Arlington Electric Railway, running from Aqueduct Bridge to Fort Meyer and Arlington; the National Cemetery, and the Brightwood Electric Railway, running from this city to Brightwood and Takoma Park. Fully one-half dozen more companies have been granted charters, and the surveys are now being made with a view to early construction.

Organization.—The formation of the Chevy Chase Land Company, with a capital stock of $1,000,000, and the purchase of their many valuable tracts of land for suburban residences, brought into existence its twin corporation, the Rock Creek Railway Company, with an authorized capital stock of an amount equal to ten per cent. above the cost of construction, and being at the present time approximately $600,000.

The officers of both companies are the same, and are as follows: Francis G. Newlands, president; Edward J. Stellwagen, vice-president; Howard S. Nyman, secretary; Thomas M. Gale, treasurer, and A. J. Warner, manager.

It is quite unnecessary to add that, with these gentlemen at the head of this enterprise, success is an assured fact.

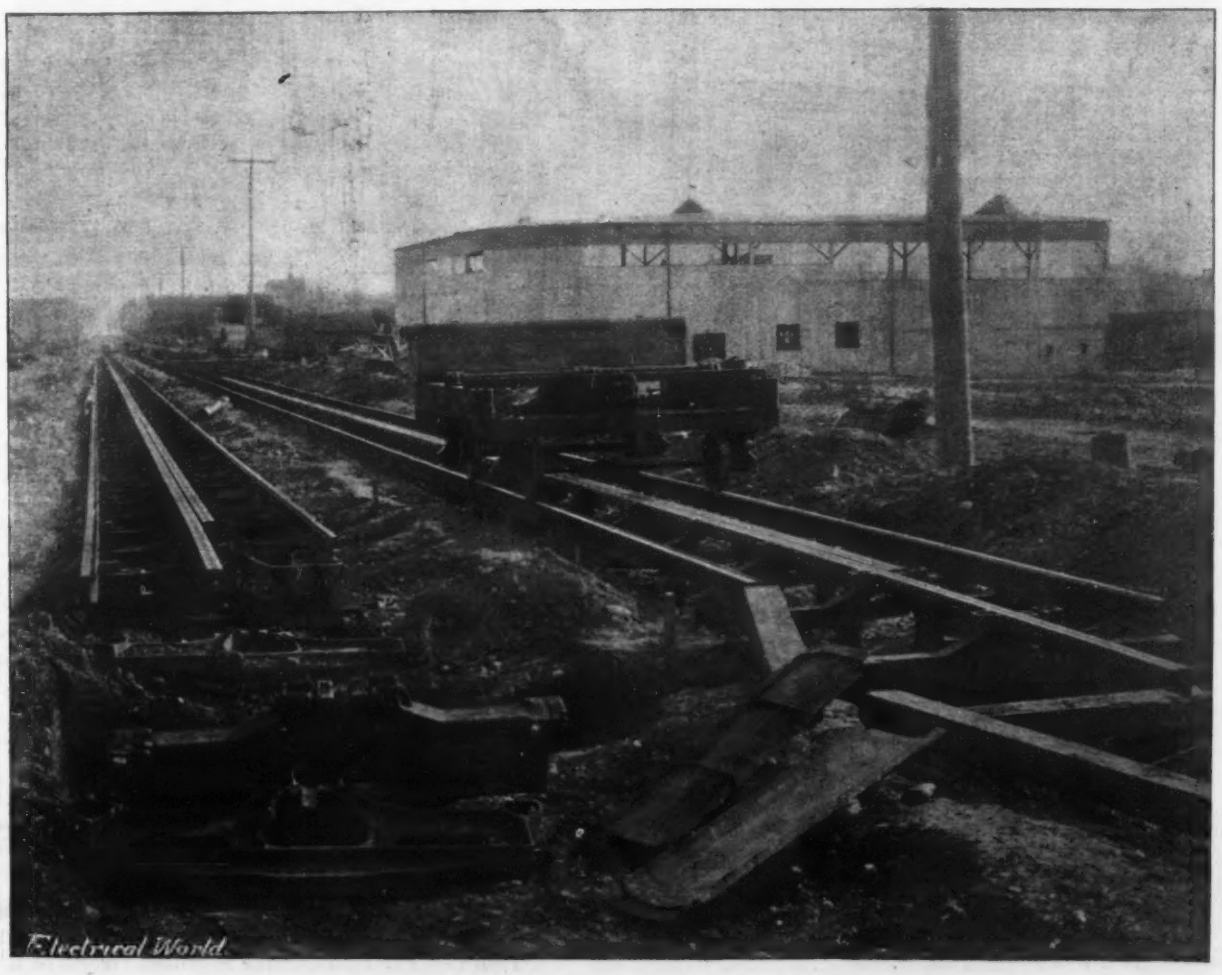


FIG. 2.—ROCK CREEK RAILWAY—LOVE CONDUIT SYSTEM.

CONSTRUCTION OF THE ROAD.

The System.—The laws of the city prohibit the use of overhead electric wires, and by reason of this the Love underground trolley system was selected, and is now being installed upon that portion of the line which is within the city.

For the suburban portion of the road the Thomson-Houston system has been installed by the General Electric Company, under the immediate supervision of Mr. S. P. Thompson, and to whom much credit is due for the very efficient manner in which the work has been carried out.

The Line Within the City.—The present city terminus, Fig. 1, is at the corner of 18th and U streets, N. W., and just outside of the boundary of the city proper, but by the middle or latter part of January it is expected that 1¾ miles of the line within the city, and extending along U street to 7th street, N. W., and thence

to N. Capitol street, by way of Florida avenue, will be completed and in operation.

As above stated, this portion of the line will be equipped with the Love underground trolley system. The current will be supplied by a separate and distinct plant, and in no way connected with the overhead trolley line. The power house is now being constructed, and will be located about 1,700 feet from the line. Insulated

FIG. 3.—ROCK CREEK RAILWAY—CHEVY CHASE.

feed wires will be laid in terra cotta pipes from the power house to the conductors underneath the tracks.

In Fig. 2 is shown a general view of the line under construction. As will be seen, the rails are supported upon cast-iron yokes placed about four feet apart. These yokes are embedded in concrete, as is also the cast-iron lining of the conduit, while a layer about ten inches deep is placed over the whole area covered by the tracks and forms a foundation for the asphalt pavement.

The yokes have two holes ⅝-inch diameter on each side of the slot, and in these are placed the iron rods between which are held the molded mica insulators. To these insulators are attached brass clamps, by means of which the conductors are supported. The trolley wire is of special design, being ⅝ inch in diameter, of hard drawn copper, and having a groove on each side slightly above the centre. The clamps above mentioned grasp the trolley wire in these grooves, leaving a perfectly smooth and uninterupted contact surface on the lower side. This method of hanging the trolley wire gives every assurance of proper support, while no portion of the latter can be worn away by constant use.

The trolley wire is cut every 500 feet, and an ingenious device inserted, by means of which all injurious effects from expansion and contraction are removed.

The slot rails are of rolled steel in lengths of about 30 feet, and are so adjusted as to be readily removable for the inspection of the conduit, or for making any necessary repairs. They have deep flanges, which completely protect the conductors from the experimental antics of "the small boy."

The conduit is 14 inches wide and 20 inches deep. It has sewer connections at short intervals, which will furnish ample drainage under all circumstances.

The trolley is supported by an iron bar ⅝ inch thick by 4 inches wide attached to the bottom of the car. It has two wheels, which are so mounted as to give complete flexibility, and good contact is assured at all times, even though irregularities in the trolley wires may occur.

With the large conducting capacity afforded by the trolley wires above mentioned, a complete insulated metallic circuit and the conduit well drained, it would seem that the loss of current by reason of leakage would be less than in the exposed overhead trolley system, at any rate no greater.

The same cars will be used throughout the line, the transformation from overhead trolley to the underground system taking place at the corner of 18th street and the boundary of the city. This operation takes but a few seconds, and is done as follows:

The car, upon arriving at the above named place, is stopped over a pit, which is opened and closed automatically. The overhead trolley is tied down, and by means of suitably arranged levers the underground trolley is lowered into the pit and makes contact with the underground trolley wires. The car is then ready to continue its trip to the city terminus, which will be at the intersection of North Capitol street and the boundary.

This road will cross four lines of double track, two of which are cable. It also connects with two other lines of railway, as well as the Herdic bus line, which is operated upon a regular five-minute schedule.

Suburban Route.—From 18th street and the boundary, N. W., the road runs north on 18th street to Erie, thence in a westerly direction on Erie street, through Cliffbourne, National Zoological Park and Woodley Park, to Connecticut avenue (extended), which it follows in a northwesterly direction to the District Line Boulevard. and at the intersection of these two thoroughfares, Chevy Chase Circle is formed. Just beyond the circle is the site of Chevy Chase, a view of which is given in Fig. 3.

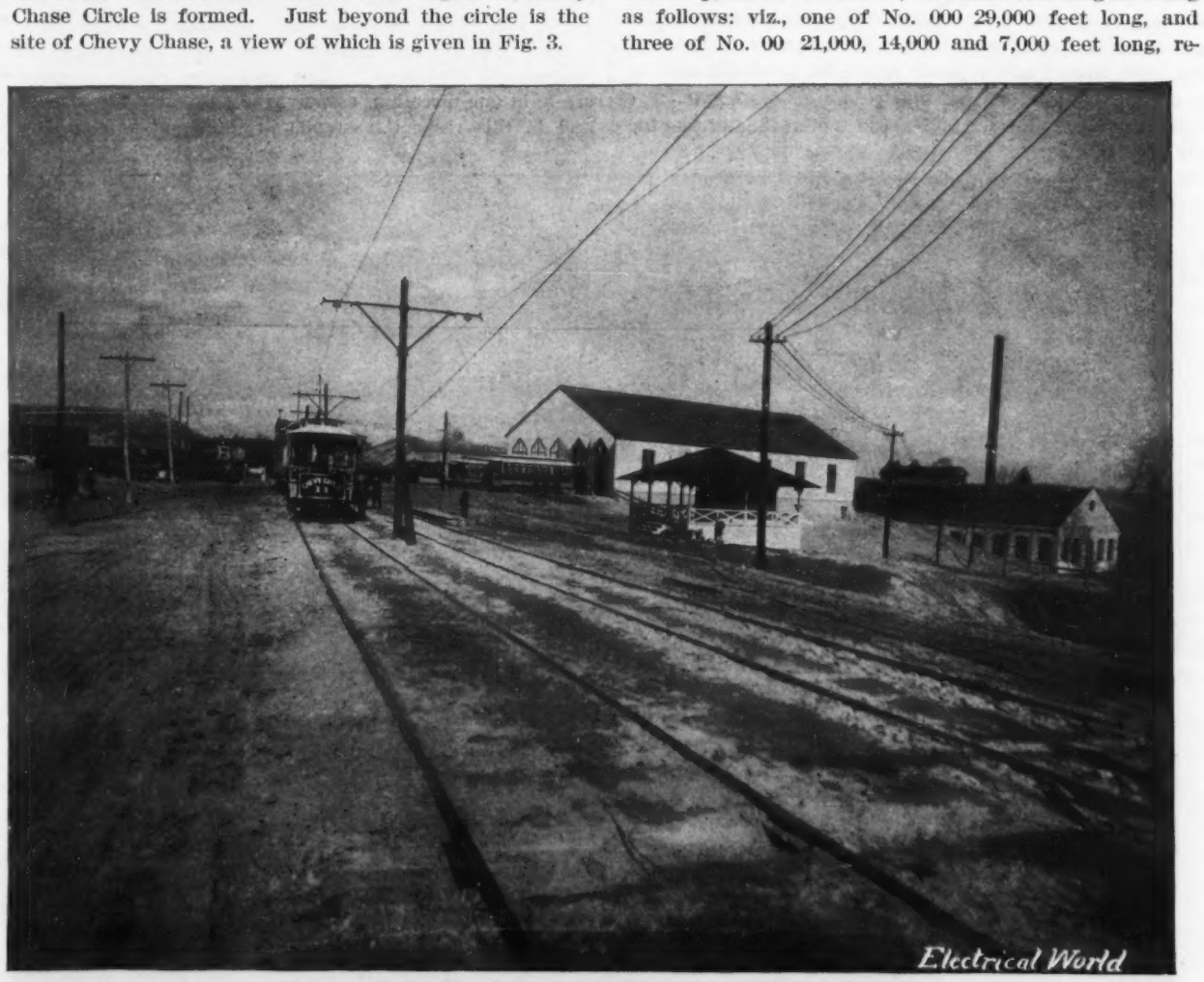


FIG. 4.—ROCK CREEK RAILWAY—COUNTRY TERMINUS.

As the last named enterprise is directly responsible for the existence of the Rock Creek Railway, a short description will be permissible.

Chevy Chase.—Within one year this beautiful tract of land will be transformed into a suburban village, which must be admired when seen. The Chevy Chase Land Company will spare no expense necessary to make it modern in every detail. It will be a model place in the fullest meaning of the word.

About twenty-five villas of exquisite design and ranging in cost from $3,500 to $10,000 each will be erected.

A hotel, club house, school house and church are being planned, and their construction will be commenced at the earliest possible moment. Several houses are already being built by private parties, and one of these will cost approximately $25,000.

A perfect system of water mains has been completed. A steel water tower 130 feet in height by 20 feet in diameter will be erected and pure sparkling water, pumped from a battery of driven wells, will be supplied to the residents at a rate considerably below city prices. A system of sewers complete in every detail has been finished. The streets will be macadamized, and the sidewalks made of rolled seed gravel. Where favorable conditions exist, there will be placed beautifully arranged terraces, adorned with broken walls, turrets and corner monuments, while foliage and flower beds will be located in desirable places. Many picturesque drives will be arranged, and, in fact, every conceivable mode of beautifying the landscape will be brought into play. The streets will be lighted by electricity and incandescent electric light will be furnished the residents at a very moderate cost.

It is safe to predict a handsome return for money invested in property at Chevy Chase, as it will, in all probability, be a popular place. The city terminus of the Rock Creek Railway will, without doubt, be in close proximity to the Capitol within one year, and this will afford Congressmen an opportunity to step aboard of an electric car, and in 40 minutes, possibly less, be taken right to the door of their suburban homes, without change of cars. It is not unreasonable to suppose that the time will come when this line will run special palace cars, heated and lighted with electricity, from the Capitol to Chevy Chase without stop, simply for the accommodation of Senators and Representatives.

Two miles beyond Chevy Chase is the country terminus, a view of which is shown in Fig. 4. The power house, car house, electric light plant and the company's operating offices are located at this end of the route.

Suburban Line Construction.—As was stated above, the Thomson-Houston system is used outside the city limits. The trolley wire is No. 0, of hard drawn phosphor-bronze, and is suspended from poles placed between the tracks. For about one mile adjacent to the city these poles are of the usual pipe construction and of very neat design, having ornamental bracing for the cross-arms. The balance of the line is supplied with a less expensive square wood pole, nicely finished and painted black. All poles are set 125 feet apart. Four insulated feeders are used to convey the current to the distant portions of the line, the sizes and lengths being as follows: viz., one of No. 000 29,000 feet long, and three of No. 00 21,000, 14,000 and 7,000 feet long, respectively. They were all manufactured by the John A. Roebling's Sons' Co.

The road bed, after leaving the improved streets of the city, was constructed with great difficulty and at an enormous expense. Connecticut avenue (extended) having as yet been unimproved, and the country being very rugged, a succession of deep cuts and fills were necessary, as well as the bridging of several deep ravines.

The total excavation amounted to 454,198 cubic yards made up as follows, viz.: Of solid rock there were 242,195 cubic yards; of loose rock, 97,407 cubic yards; of hardpan, 31,943 cubic yards, and of earth, 82,653 cubic yards,

making an average of 75,699 cubic yards per mile for the six miles of suburban road. The maximum grade will be a fraction over 5 per cent., and is about 1,900 feet long. The deepest fill is about 65 feet, at the approach to Rock Creek Bridge.

Over Rock Creek was built a substantial steel structure, shown in perspective in Fig. 5. It is 750 feet long and

FIG. 5.—ROCK CREEK RAILWAY—ROCK CREEK BRIDGE.

130 feet high, having a roadway 44 feet wide and sidewalk 6 feet wide each side of the tracks, which occupy 16 feet, making the total width of the bridge 56 feet.

Klingler Bridge is of similar construction, 550 feet long and 110 feet high, the dimensions in other respects being the same as the Rock Creek bridge.

Oak ties were used over the entire line, and were placed 2½ feet centre to centre. For city construction the Johnson grooved rail was used, while 50-pound T-rail is used upon the balance of the line. The usual return wire is placed between the rails of each track and has electrical connection with the rails at every joint.

The road is ballasted with disintegrated granite, which is taken from one of the cuts upon the line, making an admirable piece of work.

The Buildings.—The power house for the overhead system is a very substantial brick structure, 55 by 110 feet, divided into boiler and engine rooms, 55 by 50 and 55 by 60 feet, respectively. The building is well lighted, and its location one which would be difficult to improve upon. It is built upon ground which is about 12 feet lower than its surroundings, the Metropolitan branch of the B. & O. R. R. passing in the rear. This affords excellent means for dumping fuel directly from the cars into coal bins located near the boilers, and avoids hauling and extra handling.

Two creeks pass within 150 feet of the power house and furnish an ample water supply for boilers and condenser, the water running by gravitation to an immense cistern on the east side of the power house, which was constructed for the purpose.

An addition to the power house, to occupy about 25 by 35 feet, will be built to accommodate the electric lighting plant.

The car house is a well built frame structure, 60 by 130 feet, and will accomodate about 25 cars. It has five tracks, two of which are provided with a pit 5 feet deep and about 60 feet long. Cars requiring repairs to motors or trucks are run immediately over this pit, which allows of the parts being more readily examined, and the necessary work is greatly facilitated.

The company's operating office building will be of red pressed brick, with terra cotta trimmings, and, in addition to the office rooms, it will contain a neatly furnished waiting room for the accommodation of passengers.

In this building one is greatly impressed with its general excellence, which is a characteristic feature of the entire work of these companies. Houses of red brick are being built in the neighborhood of the power house for the accommodation of the railway employees.

The Steam Plant.—Steam is supplied by two water tube boilers, furnished by the Babcock & Wilcox Company, 30 Cortlandt street, New York City. Their rated capacity is 184 h. p. each at an evaporation of 30 pounds of water per hour, but, it is stated, they will easily furnish over 200 h. p. each. A blacksmith's equipment is also located in the boiler room, where all light work for the company is done.

Two engines of a rated capacity of 250 h. p. each are used. Both are high speed engines, having automatic regulation, one of which is a cross compound condensing, furnished by Messrs. Ball & Wood, of 15 Cortlandt street, New York City. It has two 84-inch driving pulleys, having a 17-inch face. The other engine is a tandem compound condensing, and was furnished by the Pierce & Miller Engineering Company, 42 Cortlandt street, New York City. The high pressure cylinder and steam chest of low pressure cylinder are steam jacketed.

By this arrangement the valves and cylinders are heated before starting, and maintained at or near the temperature of live steam during exhaust, reducing the condensation in the cylinders to a minimum, and securing thereby a more economical consumption of steam.

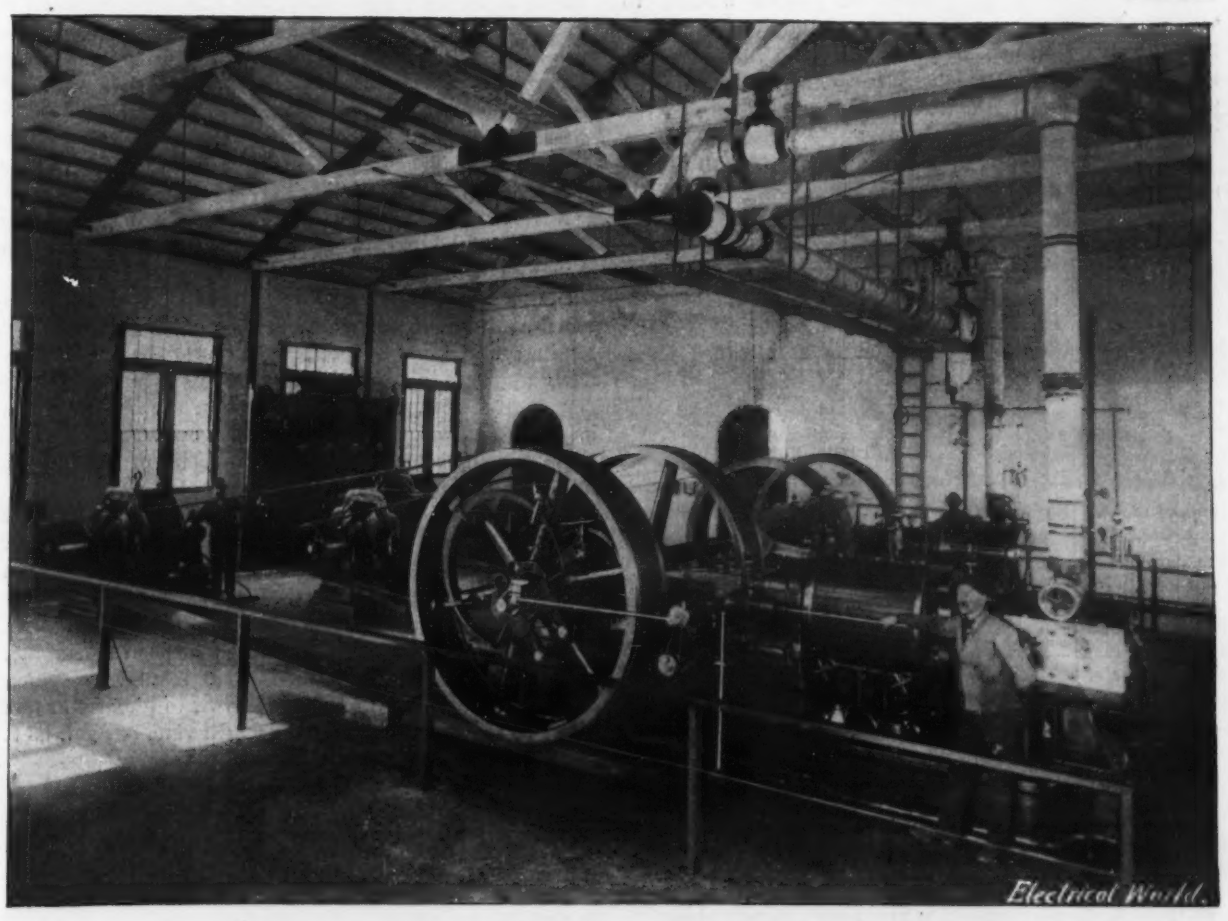


FIG. 6.—ROCK CREEK RAILWAY—INTERIOR OF POWER HOUSE.

This is especially true while the engine is working under a light load, which so frequently occurs in electric railway practice.

Another feature of this engine is a steam receiver located midway between the high and low pressure cylinders and encased underneath them. It is enveloped in a coil, through which live steam passes to the steam jackets above mentioned. The exhaust from the high pressure cylinder enters at the bottom, while the steam leaves the receiver at the top, all condensation being retained in it. By means of the exterior coil, the receiver and steam pipe connecting the cylinders are kept at about the same temperature as live steam, which very materially reduces the condensation in these parts and secures much more effective work in the low pressure cylinder. The engine has two driving pulleys 90 inches in diameter with an 18½-inch face.

A large receiver is placed on the steam main between the boilers and engines for the purpose of stopping any possible flow of water from the boilers which might occur from over work. With water tube boilers, however, the tendency to prime is very materially reduced by reason of the high steam space and large surface at the water line.

All receivers and steam pipes are tapped at their lowest point, and by means of small pipes the condensation is led to a Blake automatic return pump, by means of which it is returned to the boilers.

A Blake independent condenser is used and gives good satisfaction, maintaining a vacuum of 29 inches with ease. The condenser and return pump are located in a pit in one corner of the engine room and are reached by a short flight of iron steps. All steam pipes are covered by magnesia steam jacketing.

The Electric Plant.—Four generators of the Thomson-Houston multipolar type, 90 kilowatts capacity, are used. Two of these are driven from each engine by direct belting and run at a speed of 700 revolutions per minute. They are placed 16 feet 3 inches and 23 feet from centre to centre of driving and driven pulleys, the latter being 25 inches in diameter with 13-inch face.

This arrangement necessitates a long and short belt, but economizes in room.

Thirteen-inch perforated belts are used, and were manufactured by Chas. A. Schieren & Co., 45 to 51 Ferry street, New York City. They give perfect satisfaction. The perforations in this belting reduce the tendency to "air cushion," and hence avoid the slipping of the belt due to this cause.

The switchboard is a very neat piece of work, the frame being of oil-finished oak, while the panels are of marbleized slate. Electric light will be supplied by alternating current apparatus, contract for which has not yet been awarded. The capacity of the plant will be 2,000 16-c. p. incandescent lamps.

Car Equipment.—At present the road is equipped with 25 cars, six of which are closed motors, 28 feet long, having Robinson radial trucks, and T.-H., W. P., 50-h. p. motors; six closed motors, 16 feet long, with Peckham trucks and T. H., S. R., 30-h. p. motors; six open and six closed trail cars, all being 16 feet long and having Peckham trucks. The cars were made by the Lamokin Car Works, Chester, Pa. The other car is a freight motor, manufactured by the Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa., and is shown in Fig. 7. It is 30 feet long by 9 feet 2 inches wide, and its carrying capacity is 25 tons. The equipment consists of four Westinghouse single reduction motors of 30 h. p. each, two being on each truck. There are two special controllers made for this particular equipment and also two standard Westinghouse reversing switches. A cut-

out block is placed upon each truck, and any one of the motors can be cut out of the circuit without interfering with the others. The balance of the apparatus is of standard Westinghouse make. At a recent trial of the car it was loaded with sewer pipe and trailed an ordinary B. & O. R. R. flat car loaded with sand, the entire load being readily pulled over a five per cent. grade. It has reached a speed of 35 miles per hour on level track.

Car Tests.—A recent test of a long and short car furnishes the following data: The first car tested was 28 feet long, equipped with Robinson radial trucks and T. H., W. P., 50 h. p. motors. The total weight of the car and passengers was about 20,000 pounds. The average power used on the out trip was 12.2 h. p., while 13.4 was used on the return trip. The current for the round trip averaged 19.7 amperes at 465 volts. The distance covered was 13 miles, consuming 64 minutes time, making an average speed of 11.2 miles per hour. On the heaviest grade, which was slightly more than five per cent., the current used was 55 amperes at 495 volts, and a speed maintained of 9.4 miles per hour. The power developed on this grade was 36.6 h. p. On a one per cent. grade the current used was 30 amperes at 500 volts, developing 20.1 h. p. The speed was 13 miles per hour.

The next car tested was a 16-foot car with Peckham trucks and T. H., S. R., 30 h. p. motors. The total weight of the car and passengers was about 15,000 pounds.

The current used on the five per cent. grade was 46 amperes at 492 volts, developing 30.4 h. p. The speed was 8.5 miles per hour.

The next test was a 28-foot car with Robinson radial trucks and having T.-H., W. P., 50 h. p. motors, this car trailing the Westinghouse freight motor weighing 31,000 pounds. The total load, including passengers, was 52,000 pounds. On the out trip the average current was 54 amperes at 473 volts, developing 34 h. p. On the return trip the current averaged 55 amperes at 449 volts, developing 33.3 h. p. The average current for the round trip was 54.6 amperes at 466 volts, while the average horse power was 34. On the five per cent. grade the motors developed 76 h. p. and consumed a current of 135 amperes at 420 volts. The speed was six miles per hour. On a three per cent. grade the current used was 33 amperes at 404 volts, developing 50.4 h. p. The speed was seven miles per hour. The efficiency was calculated as being 76 per cent. The drop in potential was at no time greater than 100 volts.

Operation.—The summer schedule for week days will provide a car every 12 minutes, while cars will be run every six minutes on Sundays. In the winter a 20-minute schedule will be maintained during the week and the number of cars increased for Sunday work as required.

By way of securing patronage this railway will have a great advantage over other suburban railways in this vicinity, from the fact that the U street extension within the city will cross every street railway in operation. This will also be much appreciated by people wishing to visit the National Zoological Park, as they can take any line of cars which may be convenient and then take the Rock Creek Railway, which wil carry them right into the park, a spur from the main line having been put in for this purpose.

The company expects to carry from 5,000 to 10,000 passengers per day during the summer months.

Moonlight Tables for January, 1893.

Herewith we give Mr. H. W. Frund's table of lighting hours for the month of January, under his modified form of moon schedule:

TABLE NO. 1.
Standard Moonlight.
Philadelphia System.

Date.	Light.	Date.	Exting.
1	No light.	1	No light.
2	No light.	2	No light.
3	No light.	3	No light.
4	5:20 P. M.	4	8:10 P. M.
5	5:20 P. M.	5	9:20
6	5:20	6	10:30
7	5:20	7	11:30
8	5:20	9	12:30 A. M.
9	5:20	10	1:40
10	5:20	11	2:40
11	5:20	12	3:40
12	5:30	13	4:40
13	5:30	14	5:40
14	5:30	15	6:20
15	5:30	16	6:20
16	5:30	17	6:20
17	5:30	18	6:20
18	5:30	19	6:20
19	5:30	20	6:20
20	5:30	21	6:20
21	5:30	22	6:20
22	9:20	23	6:20
23	10:30	24	6:20
24	11:40	25	6:20
25			
26	12:50 A. M.	26	6:20
27	2:10	27	6:10
28	3:20	28	6:10
29	4:30	29	6:10
30	5:30	30	6:10
31	No light.	1	No light.

Total hours lighting, 231.10.

TABLE NO. 2.
Frund's New Moonlight System.

Date.	Light.	Date.	Exiting.
1	5:15 P. M.	1	12:00 M.
2	5:15	2	12:00
3	5:15	3	12:00
4	5:20	4	12:00
5	5:20	5	12:00
6	5:20	6	12:00
7	5:20	7	12:00
8	5:20	9	12:30 A.M
9	5:20	10	1:40
10	5:20	11	2:40
11	5:20	12	3:40
12	5:30	13	4:40
13	5:30	14	5:40
14	5:30	15	6:20
15	5:30	16	6:20
16	5:30	17	6:20
17	5:30	18	6:20
18	5:30	19	6:20
19	5:30	20	6:20
20	5:30	21	6:20
21	5:30	22	6:20
22	5:40	23	6:20
23	5:40	24	6:20
24	5:40	25	6:20
25	5:40	25	12:00 M.
26	12:50 A. M.	26	6:20 A.M.
26	5:40 P. M.	26	12:00 M.
27	2:10 A. M.	27	6:10 A.M.
27	5:40 P. M.	27	12:00 M.
28	5:40	28	12:00
29	5:40	29	12:00
30	5:40	30	12:00
31	5:40	1	12:00

Total hours lighting, 310.15.

Suggestions for Metering Devices.—I.

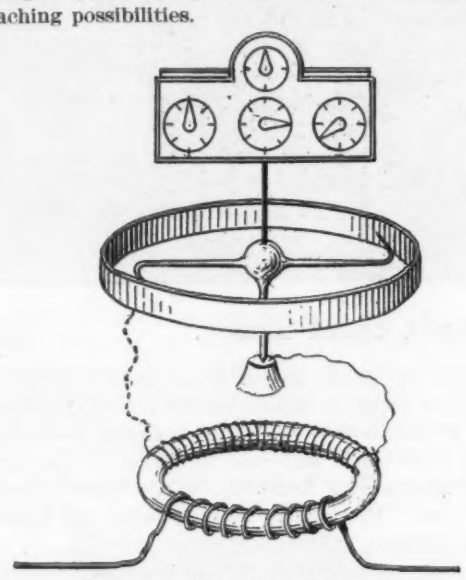
BY S. D. MOTT.

The generality of electric meters in commercial usage to-day, and the metering devices, which are not in use, but are known to the art, are expensive pieces of apparatus both in construction and economy of operation, and I believe needlessly so. The instrument of the future for measuring the amount of current consumed, I am sure, will be found a very simple and inexpensive adjunct in the various electrical industries in which such apparatus is necessary or desirable.

It is a matter of wonder why the electric meter has not kept pace with other lines of electrical development. The reason, from a scientific standpoint, is that the electrical department of natural philosophy is in its most important formative stage. Such being the case, and because of the lack of commercial necessity for such instruments, it does not advance—it lags behind.

It has not kept pace with its counterpart—the gas meter of commerce—though basic principles on which to build seem numerous when compared to the problem of measuring the volume of an entity like gas.

The basis of the gas industry is the distribution of gas under normal pressures, which is a fixed fact, and does not appear to vary or modify. The basis of the electrical industry is the distribution of electricity, but its characteristic phases and phenomena seem infinite. We start with the continuous flow of current, then the alternating and pulsating current, and have recently seen this exalted by scientific demonstration to the marvelous manifestations of alternating currents of high potential and frequency, which opens up another wonderland of far-reaching possibilities.



Electric Metering Device.

There is another reason for this lack of development of a more practical and pecuniary character, and that is the lack of independent inventive effort and research. There is no field, apparently, for this instrument on an independent business footing. It is an instrument of precision—it cannot be wholly perfected on theory—and progress is confined to those having experimental facilities of the most expensive sort, such as are found in possession of existing corporations, whose scope of research spreads over and crosses the whole field of their particular business.

Nevertheless, this should not entirely discourage independent thought in those who make of invention something of a recreation and pleasure.

I have had something to do with this interesting apparatus at different times, and have some suggestive ideas bearing upon this subject, which may be of interest. They apply to metering devices of the cheaper and non-complicated sort. The one shown in the cut is, so far as I know, novel, and appears to have a sound scientific basis, which is found in the phenomena of currents of high frequency and potential.

I have also devised a direct reading meter made wholly of glass. The device here shown, from its encroachment on the plane of electrostatic phenomena, may be called a static meter for high potential currents.

The principle of its operation is the transformation of the ordinary commercial current to a tension resembling a static condition, then measuring it and recording the measurement by any device known to the art; in this case I have selected the electric whirl, vane or flyer, as it is variously called.

The extent of this transformation and the arrangement of details to obtain the most satisfactory results are of course a subject for experimentation, and beyond the intention of this article. It may be carried out on the line of high potential and frequency, or on a lower plane of periodic pulsation, as would best serve the problem in hand.

The electric flyer, it may be needless to state, consists of metallic arms, radiating horizontally from a common centre, about which they can turn freely, and all bent in the same direction at the ends, which are pointed. Its turning movement is due, as is well known, to the accumulated electricity at the points, in a state of high tension, passing into the air, and there being dissipated; in other words, there is a mutual repulsion between the pointed ends and the electrified air, which flows off from them and is imparted to the adjacent air by conduction. This effect is so strong that the breeze from the point is sufficient to extinguish a candle. The rapidity of the revolutions of the flyer measures exactly the static charge, and the static charge in turn is proportional to the strength of current on the consumption circuit. The adjustment and calibration may be effected by adjustable weights on the flyers, or by a choke coil, movable core, or other form of dimmer.

I have shown in the drawing the flyer environed by a metallic surface, which may or may not be connected with the terminal of the exalted current circuit. It will be observed that for economy of operation and cheapness of construction this device is all that could be desired. Quod erat demonstrandum.

A New Meter for Registering for Varying Rates.

A meter is about to be introduced in England which, besides being very simple, introduces a new feature into meter work, as it may be made to register for different rates during the day hours and the night hours, and therefore solves the problem of enabling companies to charge different rates for these different parts of the day without being imposed upon by dishonest consumers, or having to run separate mains, or to send attendants out to turn off the day currents at the consumers'.

This meter, known as the Scott meter, is shown diagrammatically in the adjoining figure. *A*, *A* are fixed coils through which the consumer's current passes. *B* is a movable coil suspended at the top like a pendulum; through this coil a shunt current (and therefore a measure of the voltage) is sent periodically, at timed intervals, from the central station. This circuit, therefore, requires a special lead from the station; it is connected to the meter at the binding post *B*. When this current enters the meter it passes through the magnet *K*, thence through the coil *B*, and from there to the mains. The magnet *K*, in descending the rod *H*, causes the lever *F* to engage in the smallest wheel of the integrating train of registering dial wheels. The movement of the suspended coil *B* to the left, due to its

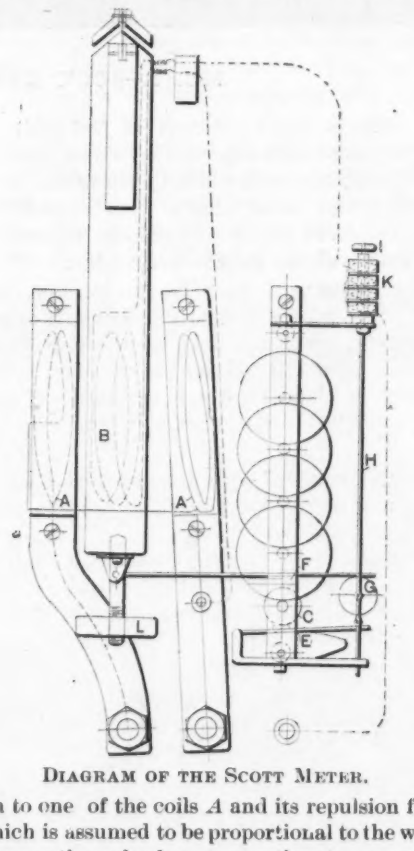


Diagram of the Scott Meter.

attraction to one of the coils *A* and its repulsion from the other, which is assumed to be proportional to the watts consumed, turns the wheel a proportionate amount. On breaking the current again the coil curves back to its original position without registering, as the magnet *K* operates more quickly to raise the lever *F*. *L* is an adjustable weight.

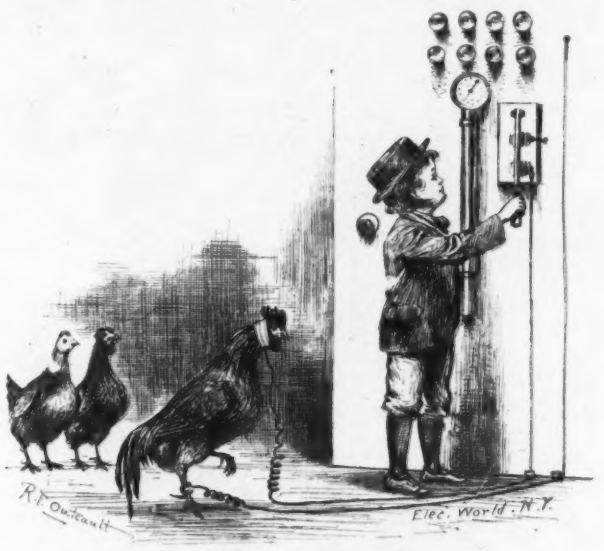
The principle of this "weighing" the current is certainly a very good one. It is stated that these meters have an accurate range of over one hundred fold which could be increased if desired. The meter registers in Board of Trade units. The current is closed every 90 seconds, for a period of 1½ seconds. The central clockwork makes connection with six circuits of meter wires; and as the resistance of the shunt circuit of a meter is about 1,500 ohms there may be 45 meters on each of six circuits, or 270 in all, for a total current of 3 ampères. A relay may be placed in the junction boxes for distant consumers. Its simplicity is claimed to make it cheaper than the extra cost of the additional lead.

If instead of sending this extra current through the meters every 90 seconds, it is sent say every 180 seconds, the meter will register only half of the current really consumed. This might be done during the daylight hours, and would then correspond to a reduction of 50 per cent. in the day rates as compared with night rates. Instead of 180 seconds any other time may be taken, according to the relative rates to be charged. Such a system would doubtless result in a more extended use of motors, and would therefore be a benefit to both the consumers and central stations.

Applications of Electricity to Agriculture.—V.

UITABLE sources of supply remain yet to be considered in the discussion of the applications of electricity to use in country districts, whether these be isolated central stations or systems of distribution covering a large section of the country, the lines radiating from a central station and supplying a district of three to five miles in radius.

The isolated central station can be employed, of course, only in connection with very large farms where considerable power is required for various uses, and where electric lighting can be utilized both about the residence and barns, as well as about the lawn and barnyard. Of course, however, there are situations in which a small isolated plant could be installed and operated economically where only a limited amount of power was needed. Such might be the case, for instance, where a waterfall within reasonable distance from the farm buildings could be utilized for the generation of current. There are, doubtless, thousands of such places scattered all over the country where water power could be utilized in connection with the applications of electricity in farm work. The installation of a small water-wheel capable of driving a dynamo of sufficient capacity could be used either for the direct supply to motors and lights or for the charging of a battery of storage cells which could afterward be switched



EXPENSIVE, BUT EFFECTIVE.

into circuit on the lighting or power mains. As every one knows there are now very few instances where waterfalls that are to be found upon small streams running through the farming districts are or can be economically utilized, except by the installation of an electrical plant. No system of distribution could be simpler than that which would be needed where a small and steady supply of water could be applied for this purpose. The mains could be carried from the waterfall, provided that it was situated at some distance from the barns, to some central distributing point in the vicinity of the residence or farm buildings, and from this point lines could be carried to motors placed about

HATCHING CHICKENS BY ELECTRICITY.

the barns, for pumping, grinding and various other purposes; to the shop for application to machine tools; for lighting purposes; to the lawn for the operation of an electric fountain; to the house for pumping, and various other uses which have already been described in this series of articles.

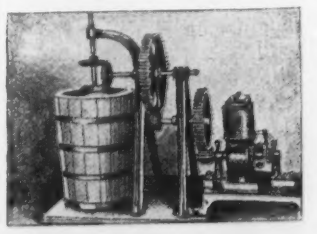
There is another source of power which, of course, is always at the disposal of the farmer, namely, the wind. This is, of course, as everybody knows who has traveled over our Western States, already very extensively used for the pumping of water, and on large farms for grinding, feed cutting and similar purposes. In the far Western States, Kansas and Nebraska, for example, there are sections where one may count from

RAPID TRANSIT.

a single location over 100 windmills, but this is in an exceptional region where to secure good water it is necessary to go to the depth of 200 or 250 feet. The application of the windmill for driving the dynamo to generate electric current is not a new one, although it has not come into very extensive use owing to a number of causes. One of these doubtless is the fact that there has been no real demand on the part of the farmer for a windmill and accessory apparatus designed for the special purpose of generating electric current. That such plants can be made a success is proved by the fact that a number of them have been built and made to work satisfactorily. The most objectionable feature, of course, is the unsteadiness of the power. In some sections of the country, however, the winds during a large part of the 24 hours of each day are fairly constant, and in such cases this source of power is all that

UGGESTION FOR A CENTRAL STATION.
A New Field for the Storage Battery.)

could be desired. In other localities, however, the winds are very variable and unsteady, and could not be depended upon from day to day. In connection with a windmill plant it is necessary to have a set of storage batteries which assist in utilizing all the current which can be generated by the windmill with its dynamo, whether the wind is blowing at the time the current is wanted for lights and motors, or whether it is impossible to secure power direct from the dynamo when it is wanted. With a plant of this kind, provision will be made for deriving power either direct



MAKING ICE CREAM BY ELECTRICITY.

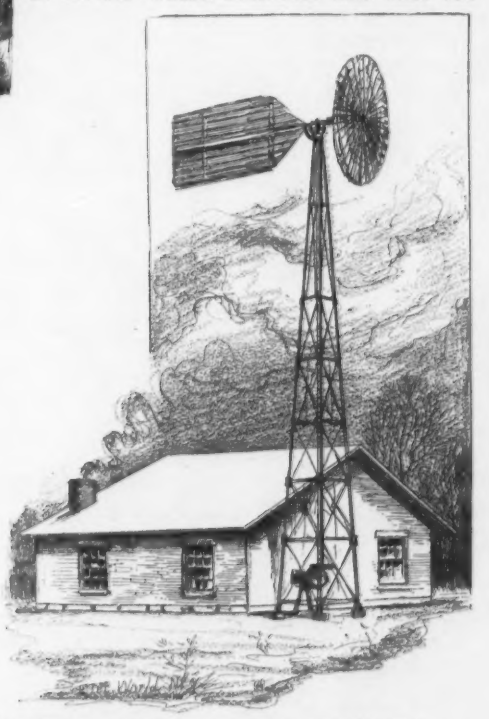
from the storage batteries or direct from the dynamo, just as would be the case with a water-power plant.

The installation of an isolated plant using steam power would be more expensive both as regards first cost and subsequent operation and maintenance. The cost of maintenance would be especially important to be considered in sections of the country where fuel is costly. There are sections, however, where, fuel being an unimportant item, the steam plant might be found the most expensive one.

The general distribution of electricity through a country district from a central station supplying a large territory would be a novelty only as regards the use which is made of the current. Such plants are already in use in many parts of the country for the distribution of current to be used in different parts of the city, or for that matter in different towns and cities both for lighting and power purposes. In this respect the plant would differ in no essential particular from a system of distribution where the current was to be used for farming purposes. A central station could be located where power was found to be the cheapest and where other conditions that always require consideration in the location of the central station indicated that the best results could be obtained. From this central station an electric road for rural service could be operated, such a line, for instance, as was described in the fourth article on this subject in The Electrical World, Dec. 31, 1892. The pole line, which would carry the motors for such a road, could be utilized for telegraph and telephone lines and the mains from which power would be distributed to the different farms along the route of the electric railway.

DUMB WAITER OPERATED BY AN ELECTRIC MOTOR.

In this series of articles we have been compelled to deal as a matter of necessity with ideal conditions. No system of distribution is yet in actual operation, but the problems involved do not differ from those found in systems of distribution that have already been found a profitable investment. What is needed to give an impetus to the applications of electricity for this class of work is a plant on quite an extensive scale in some good locality where all sorts of farming operations are actually carried on by means of electric power. An example of this kind would be of the highest value in introducing the electric motor for farm work, and any electrical concern that cares to make an installation for this kind of service would doubtless find that the



AN ISOLATED PLANT IN THE COUNTRY.

field was an almost unlimited one, and that the demand once created would increase with surprising rapidity.

American Institute of Electrical Engineers.

The seventy-third meeting will be held at the headquarters of the Institute, 12 West 31st street, Tuesday, Jan. 17, at 8 p. m. The paper to be presented is entitled "Electrical Recording Meters," by Mr. Caryl D. Haskins, manager of the meter department of the General Electric Company, Boston, Mass.

Beginning with this meeting the new arrangement for the publication of papers goes into effect, by which the advance copies usually printed for the use of those in attendance will be made the regular mail edition of the "Transactions," and it is the intention that they shall reach the membership on or before the date of the meeting. Owing to the frequent delay of printed matter in the New York Postoffice, those who may wish to participate in the discussion are advised to have a copy mailed at first class rate, which will be done upon application to the secretary.

The council will meet in the secretary's office at 5 o'clock on the same day.

Passenger Traffic in Great Cities.*

For general purposes we may consider that the average speed of a pedestrian is about 260 feet a minute, or nearly three miles an hour. Where the home and place of business are within 10 minutes' walk, or half a mile apart, the average man goes home to his dinner in the middle of the day and returns to his place of business, taking out of his day about 20 minutes, and occupying one-third of his resting time in his passage to and from his resting place, or if his business is such that he is required to go from place to place during the day within the limits of a mile or two, the proportion of his time occupied in passage from place to place is not so great as to seriously interfere with the transaction of a very large amount of business. If these limits are extended, however, to twice this distance, the condition of things is changed entirely. . . So much time is required in passing from one place to another, that it is found profitable for some of the community to provide means for more rapid communication between distant points.

. . . Some means of travel which will enable greater speed to be attained has become a necessity and the fulfilling of the demand for it in cities of more than two or three miles in length or breadth is one of the great problems awaiting satisfactory solution. In London it has been attempted to be solved by going underground, in Berlin and in New York by going overhead, and now Brooklyn, Chicago and Philadelphia are engaged in constructing overhead roads also. Whether to go overhead or underground is still agitating the minds of the centres of science and philosophy, Paris and Boston. As regards the comfort and convenience of passengers, there can be no question of the advantage of the German and American method over the English.

In attempting to solve this problem for any city, the first thing to be considered is the maximum interval of time that people are willing to spend in traveling between the place of business and the home, or generally in going from one section of the city to another. This can be determined pretty closely by considering the amount of dissatisfaction and grumbling and agitation of means of transit which has shown itself in various cities at different stages of their existence, and it appears as if the unit of time for local travel is about 20 minutes, and that whenever this time has been exceeded in any city in passing from place to place, either for business or pleasure, discontent has arisen and a demand for more speedy transit. . . . To what size cities may grow in the future is impossible to say, but at the present time it seems as if we might with safety assume that the thickly populated portion of a great city within which means of intramural, as distinguished from suburban traffic, are required, may be included within a circle of ten miles diameter, and that the 20-minute limit may be applied to distances of from seven to eight miles, with satisfaction to probably 80 per cent. of the habitual travelers.

Fundamental Principles.—With this starting point we may establish certain principles as those which should govern the construction of a system of intramural transit for a great city, and which have to be taken into account in the original laying out of a city which is destined to become great, or in the alterations of the lay-out of a city which has become great to an extent far in excess of the ideas of its original designers.

In the first place there must be a provision made for three classes of travel:

1. That which can be conducted on the surface at a speed of not greater than 600 feet a minute, or about seven miles an hour. A greater speed than this would be dangerous, as was before remarked, to persons and to property. We will call this tram transit.

2. That which can be carried at nearly double the speed of the first, or 1,200 feet per minute, with stations as close together as will enable this average speed to be maintained. It must be borne in mind here that an average speed of 1,200 feet per minute, or 13.5 miles an hour, with frequent stops of from 8 to 20 seconds each, involves the necessity for double this speed between stations, so that any motive power applied to the vehicles must be capable of starting promptly and attaining a maximum speed at the centre between stations and coming to a stop in the remaining distance. This will be found to enable stations to be placed at about one-third of a mile apart. This may be termed quick transit.

3. Then there must be an additional system provided for carrying passengers at an average speed of about 2,000 feet a minute, or 23 miles an hour, and this requires stations to be not over 6,000 feet apart. This we will term rapid transit. Greater average of speed can only be attained by placing the stations much farther apart.

Now it is not necessary, nor indeed is it desirable, that these systems should all be in identically the same location, but they should be so placed as to have numerous points of contact with each other to provide for interchange of passengers from one system to the other with the least possible expenditure of time and trouble.

A very common idea, and one which is frequently propounded by careless thinkers and writers upon rapid transit, is that the lines of speedy communication should be on important thoroughfares and co-incident with the main arteries of travel. This statement of principle has an alluring sound, and at the first glance seems to carry conviction with it, but when we consider the real object to be attained by a rapid transit system in a great city, it is found to be incorrect. The characteristic of what in a great city is termed a great thoroughfare, is that it affords rather a loitering place than a route for speedy traffic for long distances. . . . Now the object of rapid transit is not to intensify such crowds, not to bring into one district thousands of people who have no business there particularly, but whose only object in going there is to obtain the means of being carried somewhere else. It is needed to divert and dissipate such crowds, and while making the means of access to and exit from each section easy, to avoid as far as possible the concentration of masses of people in limited localities where they are not needed and in which they do not themselves desire to remain.

The object particularly to be avoided in the location of a line of speedy travel is the concentration of crowds on a single central route, and a line should be so located that it can collect passengers from outlying districts out of the reach of the main thoroughfares and deposit them at convenient points in the district of the principal business, along and in the immediate vicinity of the main thoroughfares; but rapid communication is not desired nor desirable between the several points immediately on or along the most frequented streets of the city.

Estimates of Traffic.—Now we want to know about what proportion of the population will want to travel on our roads. Experience is our only guide to this, and we must take American rather than foreign statistics, for we find that in London, so far as can be ascertained, the traffic by public conveyances is only about one-half the population daily, while in Boston and New York the daily traffic is nearly, if not quite, equal to the entire number of inhabitants. In New York the average daily number of passengers last year was 120,000 by the crosstown horse cars, 500,000 by the longitudinal lines of horse cars and 600,000 by the elevated railroads.

It is not safe, therefore, to allow for less than one trip a day for every inhabitant.

If these passengers would come regularly, distributing themselves evenly over the 365 days of the year and the 24 hours of the day, the problem of handling them would be simple. But they will not travel this way. They come like the rainfall and the wind and the temperature, and averages are as misleading in planning for their transportation as is the average travel of the wind in computing the strains on a bridge or a chimney, the average precipitation of rain in designing the spillway of a dam, or the average temperature in arranging a heating apparatus.

In the first place, there is the monthly variation of traffic, the minimum occurring generally in July, when everybody who can do so leaves a large city, and the maximum in December. There is about 20 per cent. difference in the amount of travel in these two months.

There does not seem to be any recognizable variation according to any rule in the days of the month, but there is a very marked fluctuation in the days of the week, the amount of travel on Friday being invariably about 10 per cent. below the average for the week. This is variously accounted for by those who are familiar with the fact, but the general interpretation of the phenomenon by the employés of the road is that a great number of women look on the day as unlucky, and will not shop or visit on a Friday.

Then there are special occasions to be provided for, such as a severe storm, which affects all lines alike, forcing everybody who must be out of doors into taking some means of conveyance; or a great festivity or parade, which also crowds to its utmost capacity every line of travel; or a football match, which especially affects the lines of travel leading to the scene of conflict, and incidentally also affects every line within a mile of it. Such occasions occur at no stated intervals, but they must be provided for, and the capacity of travel to be provided on any route must not be less than double the average daily duty of that line, in order to be prepared for such contingencies.

But these fluctuations of travel are as nothing compared to the hourly variations every day of the year. There is no line of traffic in a large city on which some passengers are not found to travel at any hour of the day or night, but the greater proportion by far, of course, travel by the day hours, and, in consequence of the conditions which demanded the construction of the rapid transit lines, the variations during these hours are enormous.

Hourly Fluctuations of Travel.—The illustrations of the hourly fluctuation of traffic which I shall give you are derived from the record of travel on a day which fairly represented the average travel on the Manhattan Elevated Railway in New York City, which was kindly furnished me in detail by Col. F. K. Hain, the general manager, and they no doubt represent correctly the variations which are to be expected in any great city in which the centres of business and population are widely separated.

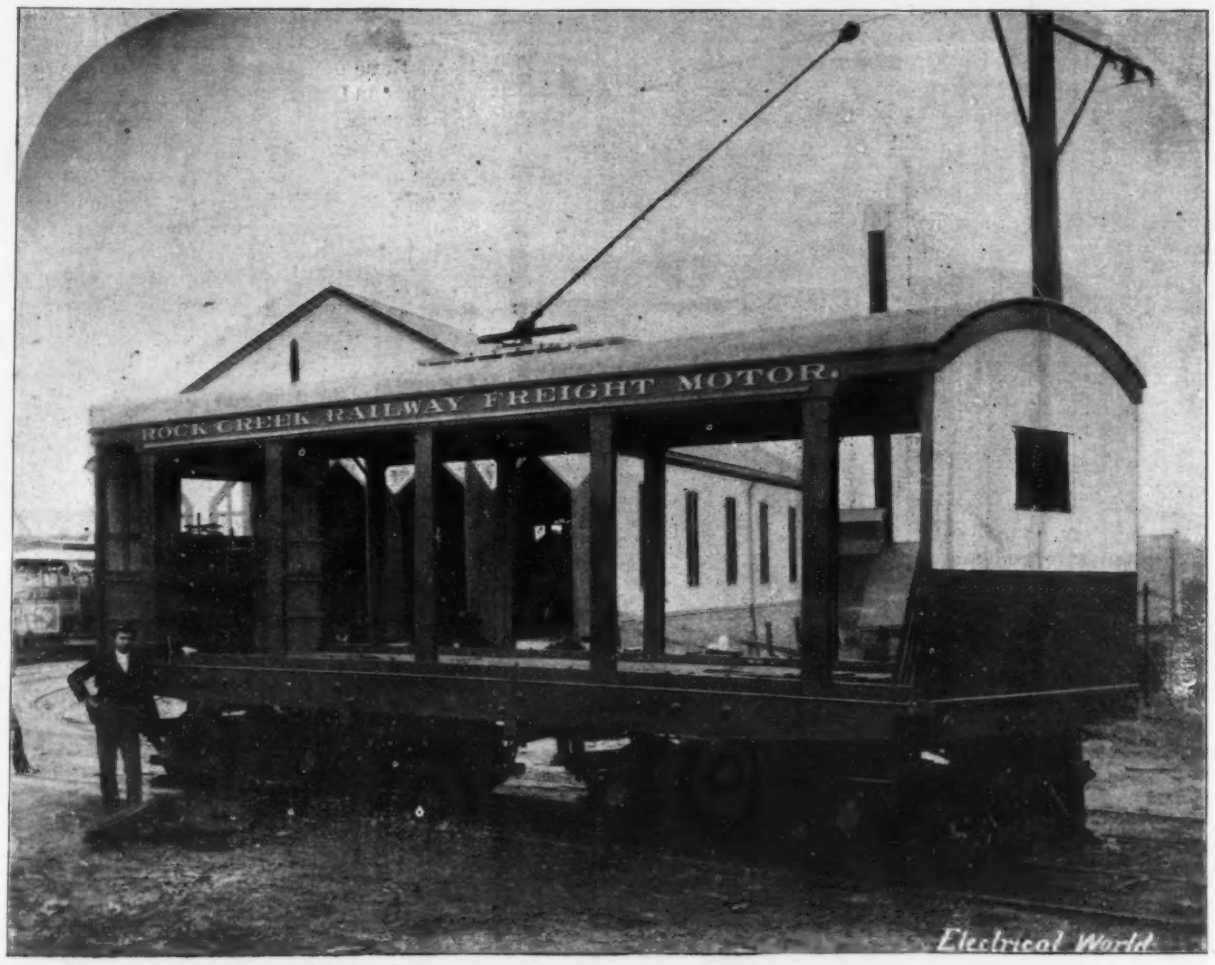


FIG. 7.—ROCK CREEK RAILWAY—WESTINGHOUSE FREIGHT MOTOR.

The hour of minimum traffic is from 3 to 4 o'clock in the morning, and during that hour there are carried only two-tenths of one per cent. of the total passengers during the day. From 4 to 5 o'clock the travel increases slowly, and from 5 to 6 o'clock about 1½ per cent. of the daily travel occurs, which increases in the next hour to seven per cent. and in the hour from 7 to 8 o'clock to 13 per cent. of the total traffic. Between 8 and 9 o'clock there are about 9 per cent. of the passengers carried and from that time until 5 o'clock in the afternoon there is but little variation, the traffic each hour amounting to about 4¼ per cent. of the total traffic, but during the hour from 5 to 6 o'clock in the afternoon all the lines are again crowded and about 10 per cent. of the total travel is concentrated in that hour. From 6 to 7 o'clock 7 per cent. of the traffic occurs and from that time until 2 o'clock in the morning the decrease is very regular down to an hourly duty of four-tenths of one per cent. of the total. The average hourly travel being one-twenty-fourth, or a little over four per cent. of the daily total, we see that the minimum hourly traffic is one-twentieth of the average and the maximum is three times the average.

Leaving out of account the exceptional crowds which are attracted to the roads by festivities and other extraordinary occasions, it appears, therefore, that in order to carry on the average daily traffic provision must be made for accommodating at stations and on trains at least four times as many passengers as it would seem necessary to provide for if the daily average alone of travel were taken into consideration. But here comes in still another consideration. There are certain districts from which a larger proportion of the passengers must be carried than the average of all districts. The greatest of these is of course the business centre, the most densely occupied in the daytime and the most sparsely populated district in the city. In the

* Extracts from an address by J. James R. Croes, M. Am. Soc. C. E., M. Inst. C. E., delivered before the students of the Rensselaer Polytechnic Institute, as reported in the *Railroad Gazette*.

city of New York this central district is in the vicinity of the City Hall.

Dividing the city into half-mile sections by circles described from the Battery as a centre, we find that the uptown travel during the busiest hour of the afternoon, between 5 and 6 P. M., which leaves the first mile from the Battery (which just includes the City Hall station of the Third Avenue Railroad), is 42 per cent. of the entire upward travel during that hour, or 2.7 per cent. of the entire traffic for the day over all lines. With a daily traffic of 600,000 passengers, there are 16,200 passengers that take the trains below Chambers street between 5 and 6 o'clock in the afternoon. If this number of passengers stood in line in single file as close as they could stand together they would make a line five miles long. These passengers take the trains at 11 different stations, but 25 per cent. of them are taken on at one station, that at the City Hall and Brooklyn Bridge, and if they should come on in a line two abreast they would form a column extending down Park Row and Broadway to below Wall street.

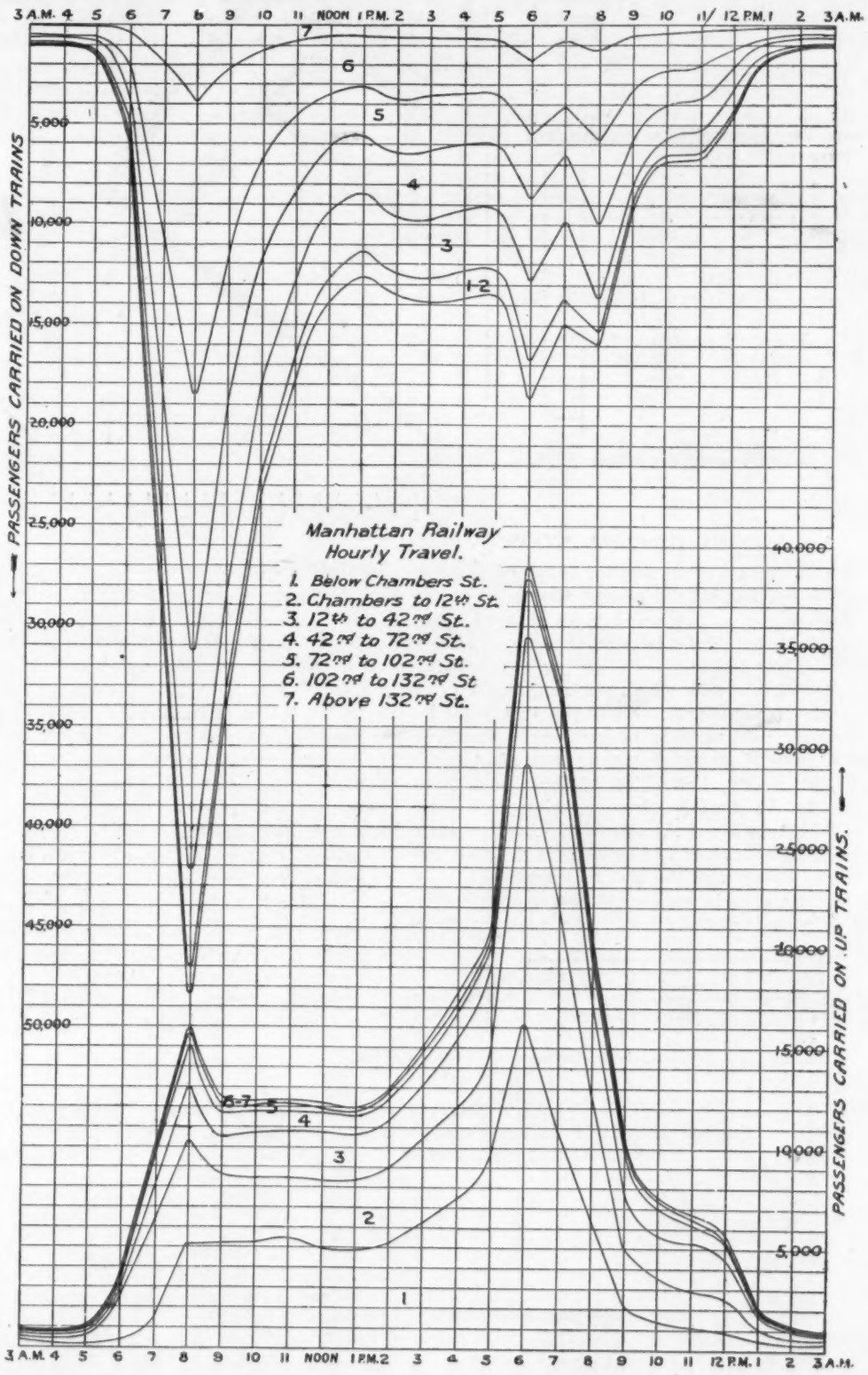
The next strip of a mile long, extending up to Houston street, furnishes in that same hour, 5 to 6 o'clock, 10,000 passengers, and within the remaining eight miles up to the upper limit of the roads only 13,000 passengers go up during that hour.

The downward travel, which curiously enough is about 12 per cent. in excess of the upward travel, is distributed over the day differently, as may be supposed. It reaches the maximum between the hours of 7 and 8 o'clock in the morning, when 49,000 passengers, or 8 per cent. of the entire daily traffic, are carried southward. Thirty thousand of these passengers come from north of Seventy-second street. From 8 to 12 o'clock the hourly traffic falls very regularly until it is 14,000 passengers per hour. From 12 to 1 o'clock there are 12,800 passengers; between 1 and 5 P. M. the hourly average is 14,000 passengers. From 5 to 6 P. M. the residents of Brooklyn and New Jersey swell the downward travel to about 19,000 per hour. Between 6 and 7 o'clock the travel falls off rapidly, but from 7 to 8 there is a considerable increase, attributable doubtless to the people uptown going down to the theatres, as the greatest travel in that hour is from the Harlem district. After 8 o'clock the decrease until 2 o'clock in the morning is very regular, except that between 10 and 11 o'clock there is a considerable accession of passengers from the central portion of the city, in which the places of amusement are situated, indicating that a considerable number of attendants at the theatres reside in Brooklyn and New Jersey.

These fluctuations of the hourly travel may be best appreciated by inspection of the accompanying diagram, which shows graphically the number of passengers who purchased tickets and took trains in each direction during each hour of Wednesday, May 18, 1892, in each of seven sections from South Ferry to Washington Heights, in New York City. The first section extends to Chambers street and is one mile long. The others are each a mile and a half long. The entire traffic as divided between the four lines of road was as follows:

	Up.	Down.
Ninth avenue	39,920	21,890
Sixth avenue	94,926	123,935
Third avenue	116,216	123,534
Second avenue	32,257	48,394
Totals	282,819	317,753

Total, 600,572.



CURVES SHOWING VARIATIONS OF TRAFFIC IN THE MANHATTAN ELEVATED RAILWAY.

The only record that is kept is that of the departure from stations, no account being taken of the number of passengers that arrive from any station, either for the whole day or during the different hours of the day, so that the destination of the passengers and the average length of the ride per head cannot be reached with any certainty. It is not improbable that a pretty accurate determination of the average distance traveled by passengers could be arrived at by a careful study of the statistics with the aid of diagrams and observations of the general character of the travelers themselves at different hours of the day at different stations, coupled with a knowledge of the class of occupancy of the different sections of the city. I do not know that such a study has been attempted by any person, but I think that it might be undertaken with the expectation of arriving at pretty accurate results.

Now these figures which we have been examining refer only to one mode of transit, that which we have called quick transit, and that on four lines running longitudinal of the city. They do not take into the account the nine longitudinal lines of what we have called tram transit, namely, that which carries passengers at about double the speed at which they can walk and of which there are 118 miles in use in the city, carrying daily at least 90 per cent. as many passengers as the quick transit lines do, nor is any account taken of the 28 miles of crosstown tram transit roads which carry about 25 per cent. as many passengers as the quick transit roads do.

The principles governing the movement of passengers on all these lines are, however, very nearly the same as those which regulate the travel on the quick transit lines. These general rules are, that the travel on one day may be double the average travel for the year; the travel in any one hour may be three times the average hourly travel for the day; the travel in any one direction alone in any one hour may be twice the entire average hourly travelfor the day; and the travel from one-half mile section alone in one hour of the day may be at least 40 per cent. of the average hourly travel for the whole day.

Practical Use of These Studies of Movement.—The practical application of these studies of variation of travel is made in providing for the equipment and operation of a road, intended for whatever grade of transit. Provision has to be made for station facilities, employés of all kinds, rolling stock and supplies necessary for maintenance and operation to meet the varying demands of each locality at different hours of the day.

It has been the custom on at least one of the old established horse car lines in New York City, and doubtless on other lines and also in other cities, to keep records of temperature, the weather, the number of cars on the road at each hour of the day, the number of employés in service, and of all complaints of defective service at the several hours of every day, and to keep these records in such shape that the results of different conditions of operation can be compared with a view to regulating the expenses and the operation in accordance with experience. It is said by the manager of one of these lines that knowing the time of year, the day of the week and the condition of the thermometer and the barometer, he can provide for the required number of cars to be sent out from the stables and the number of employés to operate the road for that day with the best results.

In providing for the daily service of the quick transit lines, as may readily be supposed, experience, good judgment and promptness in decision and action are essential to conduct the business of any day with success. The interests of the owners of the lines must be consulted to prevent unnecessary expenditure, and the interest of the public must be carefully looked after to prevent unnecessary delays or obstruction to travel.

Of course there will occur occasions even on the well managed road in which some extraordinary rush of travel occurs that is so far in excess of the capacity of the road that great inconvenience results both to the management and to the public. Such an instance occurred at the recent Columbian celebration in New York City, in which all lines of transportation were taxed far beyond their capacity, the movement of passengers being from 50 to 80 per cent. greater than the general daily average on the railroads entering the city, and on the elevated railroad lines being about 60 per cent. in such excess. On Oct. 12 the Manhattan system carried 1,075,537 people. The expression a million people does not convey any very definite idea to the mind, but it may assist us to understand what that figure means if we say that if the people who traveled on the elevated railroads on that day were arranged in single file as close as they could conveniently stand together, the line would reach from the Battery, in New York, up along the Hudson River to Albany, and out on the New York Central Railroad as far as Auburn; or they would reach from Troy to 40 miles beyond Buffalo. When we consider that probably there must have been at least 150,000 of these people who wanted to take the cars at the same time when the parade was breaking up, that this crowd would fill 300 trains of cars to their utmost capacity, and that that number of trains distributed over the entire tracks of the elevated railroads, both up and down, would leave only 300 feet intervals between trains, it is not surprising that there was considerable delay in getting on and off the trains and that travel was very slow; but it is remarkable that, so far as known, not a single accident occurred to any of the 3,000,000 of passengers that were carried in the three days, Oct. 10, 11 and 12.

Fallacy of the Continuous Circulation Idea.—It has been a favorite idea with many persons, and particularly of the class who ventilate their opinions in the newspapers over fictitious signatures, that the proper method of operating the rapid transit lines in New York City would be to complete a connection at the upper end between the lines on the extreme sides of the city, and to run trains around continuously up one side and down the other, making loops at the Battery and the Harlem River, instead of terminal stations; but a trip down Second or Third avenue and up Sixth at any time of day would very soon satisfy an intelligent person that such a scheme was entirely impracticable, and that the same cars and the same operatives were not at all fitted to handle the different classes of passengers on the two different lines.

Coal Consumption.—Among the variations in operation at different seasons of the year there may be mentioned one to which I have not before alluded, and that is the different consumption of coal required for operating the roads at different seasons of the year, due to the variations of temperature. Some variation is of course to be expected

from the amount required to make steam to heat the cars, but a good deal is undoubtedly due to the difference in radiation from the boilers with differences in outside temperature. I have found, on plotting the curve of monthly coal consumption by the same engines doing similar duty during the months in which there was no steam used for heating the cars, that the line followed very closely the line of the reciprocal of the average temperature for the same months.

Motive Power.—The question of the motive power to be applied to the city transit of the future is one of great importance. It is still undetermined whether the cost of propelling over a long route a number of trains of vehicles running at varying speed and with varying loads is greater by having the power all generated at a central station and transmitted throughout the length of the line, as in a cable or trolley road, or by having each car or train operated by an independent motor. Theoretically, proof can be made to show any one of the systems to be cheaper than the others. The system of propulsion by a steam locomotive, which must carry its crude fuel and water and generate steam as it passes along through the streets of a city, is not up to modern requirements, and something else will soon have to be substituted for it.

That a road in the open air will be successfully operated within a very short time by the use of electricity applied in some unobjectionable manner, no one, I suppose, doubts; but that foul air and deafening noise can be prevented in any system of subterranean travel I doubt whether any one really believes.

Fast Long-Distance Service.—No system of rapid transit, as distinguished from quick transit, has yet been put in operation in any city, except for a portion of the day on the Ninth Avenue line in New York. It may be worth while to consider the question of the conditions under which such a road can be made remunerative.

From our diagrams of the New York traffic, it seems as if there were only about three hours in the morning and three hours in the afternoon in which any great amount of long distance travel occurs, and it is only during these three hours, morning and afternoon, that there would be as many trains running on the rapid transit route as would be required on the quick transit routes, while during the midday and night hours fewer trains might be run. What will have to be considered, therefore, by the projector of any rapid transit route, is whether enough passengers are likely to be procured in these hours of the day to pay the expenses of operation and interest on the cost of construction. During the remaining 18 hours there is no likelihood that there will be enough long distance passengers carried to pay for the cost of operation. Suppose the road needed to be seven miles long; with a station at each mile, and that the trains would make 300 round trips. Judging from the reports of the Manhattan Railway Company for 1891, the cost of maintaining each station is about $6,000 a year, and the cost of maintenance of track and structures $15,000 per mile, and the cost of operation 40 cents per train mile. The general expenses may be put at $100,000 a year. The total cost of operation and maintenance on this basis would be $860,000 annually. To make up this sum would require an average travel of 50,000 passengers a day; in addition, to pay 6 per cent. on each million dollars that the road might cost, would require 3,400 passengers per day. By occupying a street, an elevated railway can be constructed and equipped for $450,000 a mile, but in the streets of New York City, particularly in the lower part, there would have to be added to that at least an equal sum for supposed damage to property owners, making the cost of the road not less than $1,000,000 a mile. For seven miles of road there would be required, to pay the interest on the cost at this lowest figure, about 24,000 passengers per day, and for every million dollars a mile which the road might cost, a like number of passengers, 24,000 per day, must be added. The very least number of passengers, therefore that would warrant the construction of a rapid transit road is 75,000 a day, but 60,000 of these passengers would have to be during the morning and evening hours of heavy travel. As the Sixth Avenue road alone carries in the hour from 7 to 8 o'clock in the morning about 18,000 passengers and the Third Avenue road takes up town in the afternoon in one hour 16,000 passengers, and they could take more if the capacity for carrying them existed, it does not seem unreasonable that a rapid transit road might carry 10,000 passengers an hour during this busy season of six hours daily, and therefore be able to pay its cost of operation and interest on a reasonable cost of construction. If the long distance travel in New York City should increase within the next five years as rapidly as it has in the past, it is not improbable that a rapid transit road would pay for a much greater investment than $1,000,000 a mile. Indeed, considering the growing demand for better accommodation at all hours and in outlying districts, it is quite likely that such a road might be largely renumerative by being operated as a quick transit road for a large portion of the day over the whole route, and at all times in districts beyond those which furnish the most of the long distance travel.

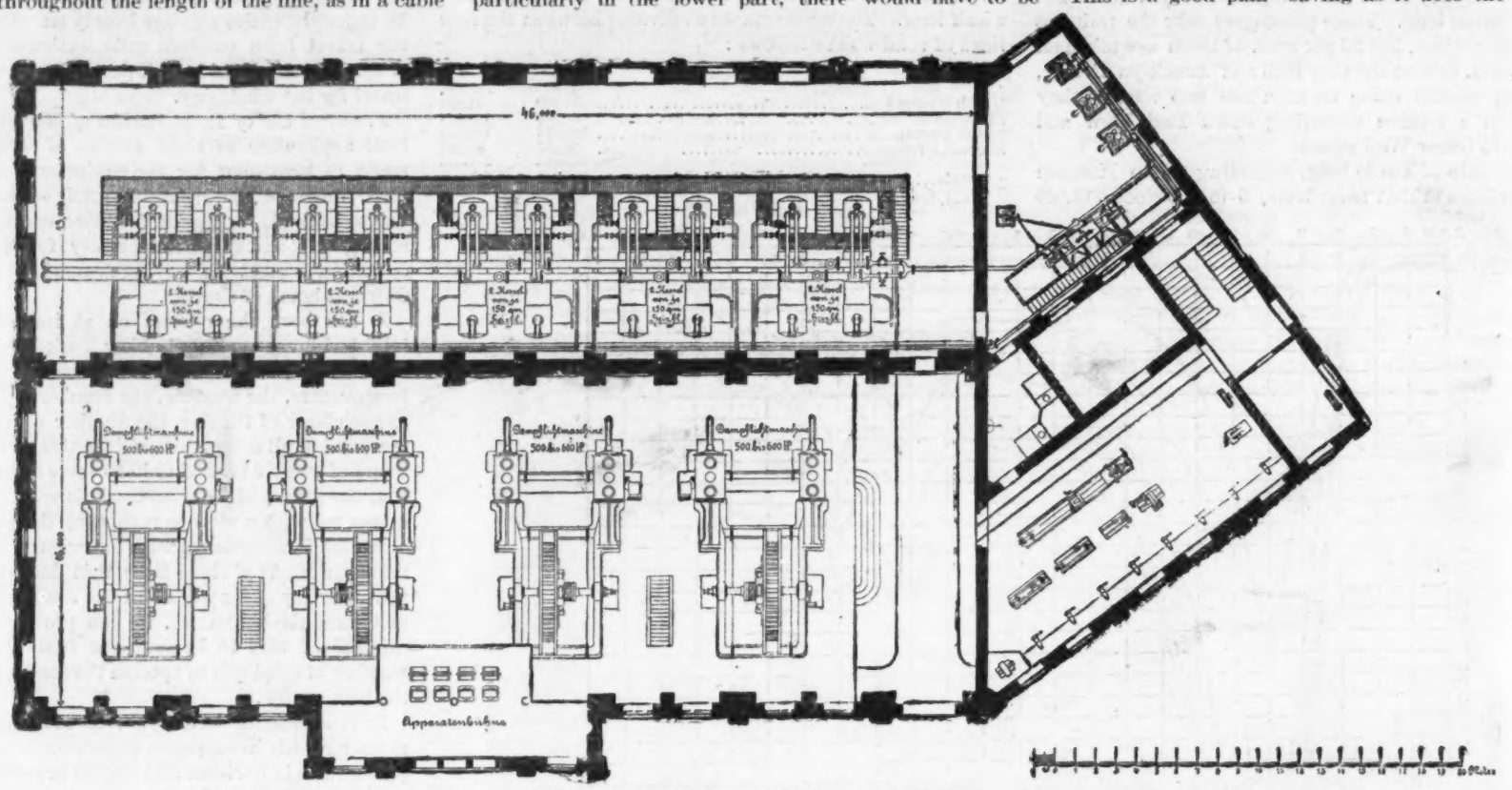


FIG. 1.—COLOGNE CENTRAL STATION.

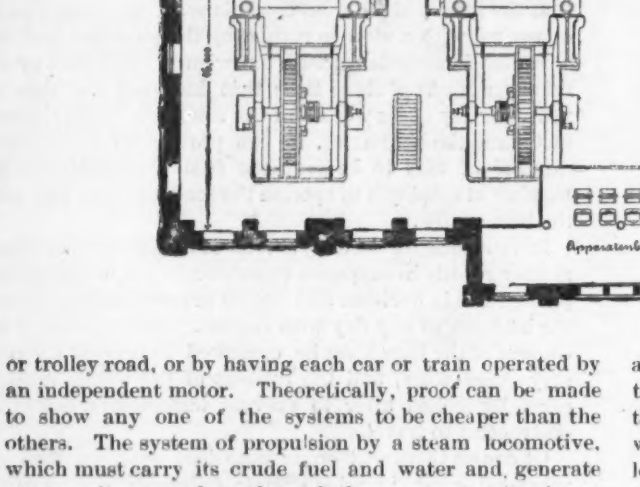

MARKS
SCALE FOR TOTAL TESTING COSTS.
MARK
SCALE FOR TESTING COSTS PER LAMP.
TOTAL FEES PAID FOR TESTING A HOUSE CONNECTION
TESTING FEES PER ONE LAMP
NUMBER OF LAMPS CONNECTED.
Elec. World

FIG. 2.—COST OF MAKING TESTS.

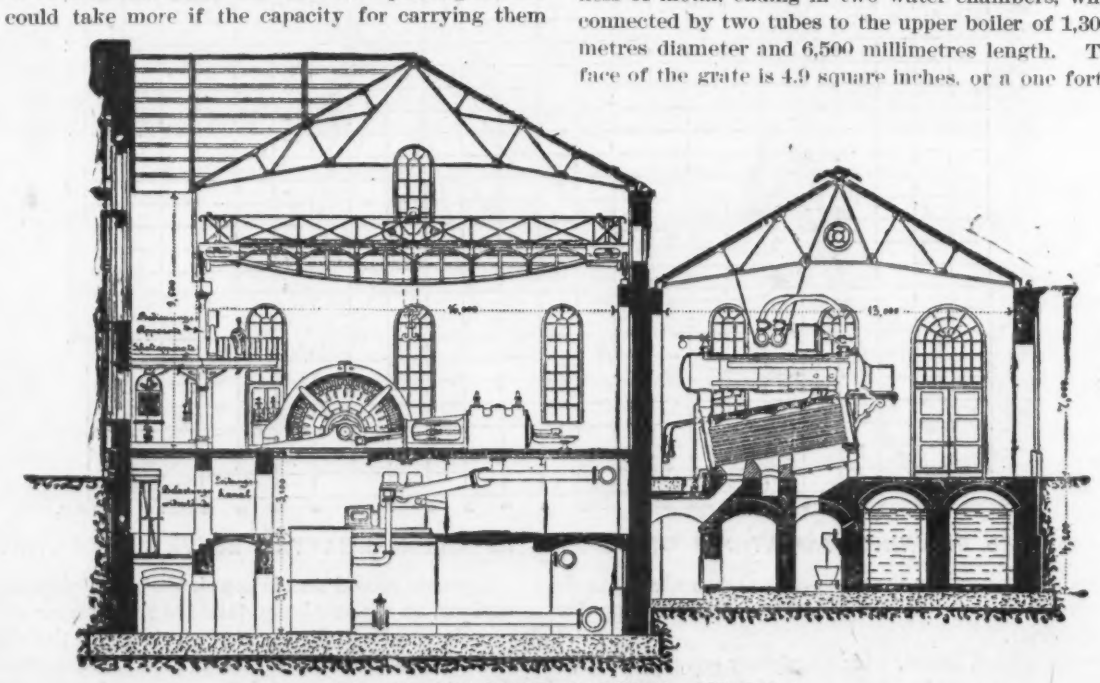


FIG. 3.—COLOGNE CENTRAL STATION.

The Cologne Municipal Lighting Station.—II.*

BY CLARENCE P. FELDMANN.

The Cologne station, of which the accompanying figures 1, 3 and 4 show the situation and two diagrams, is located next to the municipal waterworks. It is under the same administration as these and the municipal gas works, and although there exist two separate boiler houses for the two works, there is such steam piping that one set of boilers may furnish steam for both works. This was in fact done during the whole summer, the pumps of the water works having received steam from two of the boilers of the electric station. This is a good plan—saving as it does the expenses of separate workmen, of coal for getting up more steam in the evening or heating new boilers; in this way the boilers are at nearly constant load, the time of the maximum output of the water works coinciding with the minimum of the electric station and vice versa.

The boiler house, which has a length of 46, a width of 13 and a height of 7 metres, contains at present 6 Steinmueller boilers, and has room for four more, of which two will be put down this winter. Each of these boilers has a heating surface of 21.2 square metres and is tested for a pressure of 10 atmospheres, though in general it carries only 6 atmospheres. Each boiler contains 10 series of 14 water tubes of 5,000 millimetres length, 95 millimetres exterior diameter and 3½ millimetres thickness of metal, ending in two water chambers, which are connected by two tubes to the upper boiler of 1,300 millimetres diameter and 6,500 millimetres length. The surface of the grate is 4.9 square inches, or a one forty-third part of the heating surface of the boiler. Below the ashpit of each boiler there is a shoot running to a tunnel, from which the ashes may be removed.

Adjacent to the boiler house, in the triangular room, there are two Froitzheim feed water cleaners, each furnishing five cubic metres of water per hour. These cleaners, which can be fed from municipal water pipes or by means of a special pump from the condensed water that leaves the engines, work continuously by boiling and tossing the water about with a jet of steam, then mixing it with a measured quantity of chemicals and thus taking out 12 of 16 parts of hard material which is contained in 100,000 parts of water. The water cleaned in

* For the first section of this article see THE ELECTRICAL WORLD Jan. 7, 1893, p. 5.

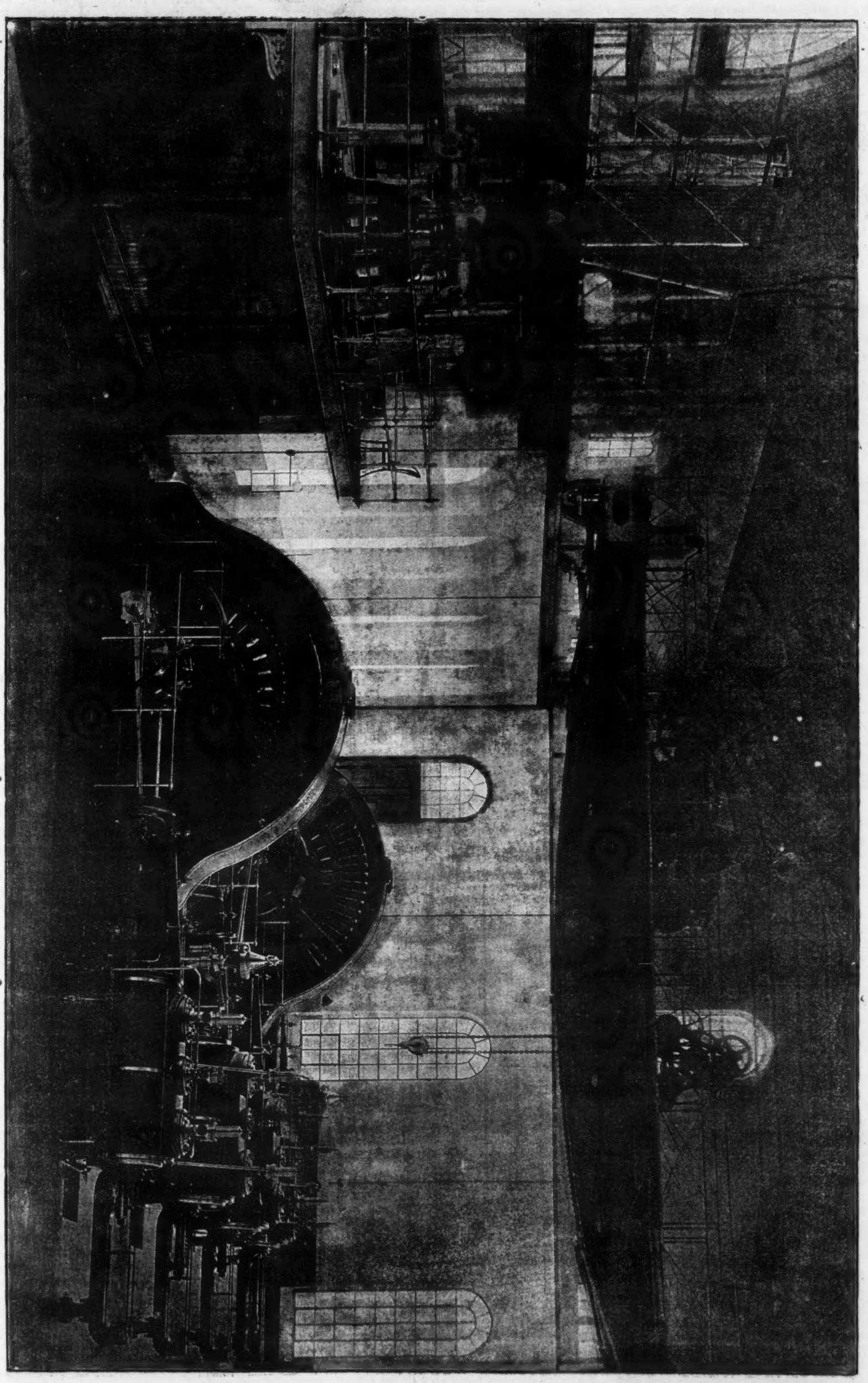


FIG. 4.—GENERAL VIEW OF THE ENGINE ROOM OF THE COLOGNE CENTRAL STATION.

this way flows to the feedwater reservoir, from which it is taken by the compound feedwater pumps working with condensation. The diameter of the plunger is 160 millimetres, the stroke is 200 millimetres, the number of revolutions 60 per minute, the capacity 23,000 litres per hour.

The engine room (Figs. 3 and 4) is the same length as the boiler house, but measures 16 metres across and is considerably higher than the boiler house, as it bears in its upper part a 30 ton traveling crane, which can travel so as to lift any parts of the engines or dynamos and set them down upon wagons placed at the spare room near the entrance shown in Fig. 1, which is broad enough to let the largest parts of engines or dynamos pass with ease. The engine room contains at present two horizontal Sulzer compound condensing engines, with a high pressure cylinder of 650 millimetres diameter, a low pressure cylinder of 950 millimetres diameter and a piston stroke of 1,250 millimetres, giving 590 or 750 i. h. p., respectively, when the steam admitted with 5.5 atmospheres fills 22 or 38 per cent. of the volume of the high pressure cylinder. The number of revolutions is 85 per minute for these engines as well as for

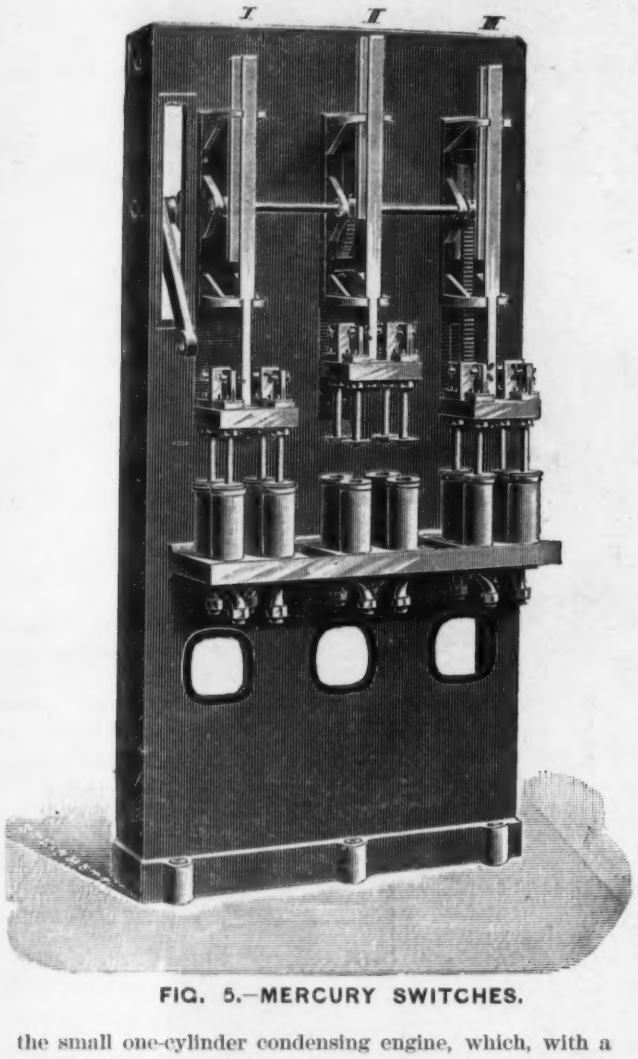


FIG. 5.—MERCURY SWITCHES.

the small one-cylinder condensing engine, which, with a cylinder diameter of 450 millimetres and 900 millimetres piston stroke, gives 125 to 150 effective h. p.

I now come to the description of those parts of the central station which distinguish it most favorably from all others which have been erected so far. Electric stations, as a rule, present an entanglement of wires ending at a fine switchboard which looks like an exhibition of some instrument maker's rather than like a set of apparatus which is destined to be handled by ordinary workmen. The engine room contains no visible wires, no complicated switchboard, no belts, and, in fact, is a simple looking machine station, the control and regulation of which is effected by a simple mechanism moving a couple of levers. It is one of the Helios company's greatest merits to have broken with the old system of making physical apparatus instead of solid mechanical constructions, a merit which was acknowledged by all the foreign visitors of the station, among whom I will here name only Mr. L. Z. de Ferranti and Mr. Nikola Tesla.

The shafts of the engines carry the hubs of the magnet wheel of the alternators, which have 72 poles and give 6,000 alternations per minute. As Fig. 1 shows, the same shaft also bears the exciter armature, while the eight poled field of the exciter is kept in position by means of four radial cast-iron arms projecting from the ring-shaped frames to which the armature coils of the alternator are attached in the well-known Zipernowsky manner. Armature and field of both alternators and exciters are completely built up of iron sheets, half a millimetre (20 mils) thick. The weight of iron in the exciter armature is nearly 1 ton 2 cwt. for the 600-h. p. dynamos and about 14 cwt. for the 125-h. p. dynamos. The weights of copper are respectively 6½ cwt. and 4½ cwt. upon the armatures, and 13 cwt. and 9½ cwt. upon the field magnets of the exciters, which are shunt wound for the small dynamos and compound for the large dynamos. The rather high weights are due to the low number of revolutions, but it must be stated that one of the large exciters can furnish all the current necessary to excite two 600-h. p. alternators. The output of the latter is 200 amperes at 2,000 volts, that of the small dynamo is 40 amperes at 2,000 volts. The alternators are intended to work in parallel on the network, and did so all the winter; moreover, they run parallel service every day, when the day load is switched over from the small dynamo to the large ones, as the load increases. For these operations the manager constructed the lever work (Figs. 6 and 7), by means of which one alternator may be switched in to work in parallel with one already working, by the following series of operations. Lifting the handle of the bolt d, the lever d is moved until it fits into the first slot of the circular disc shown. By this movement we have connected the shunt field of the exciter to the brushes, after which, but not before, can we move the lever c slowly on, regulating by this movement the excitation of this field. When the compound exciter of the running dynamo and the exciter of the dynamo to be introduced show an equal voltage, we place the bolt d in the second notch and then move the lever a until its bolt fits into the first hole of the corresponding disc, thus completing the exciter's main circuit, and exciting the alternator's field, which may be suitably regulated by introducing resistance by means of the lever b. So far no damage

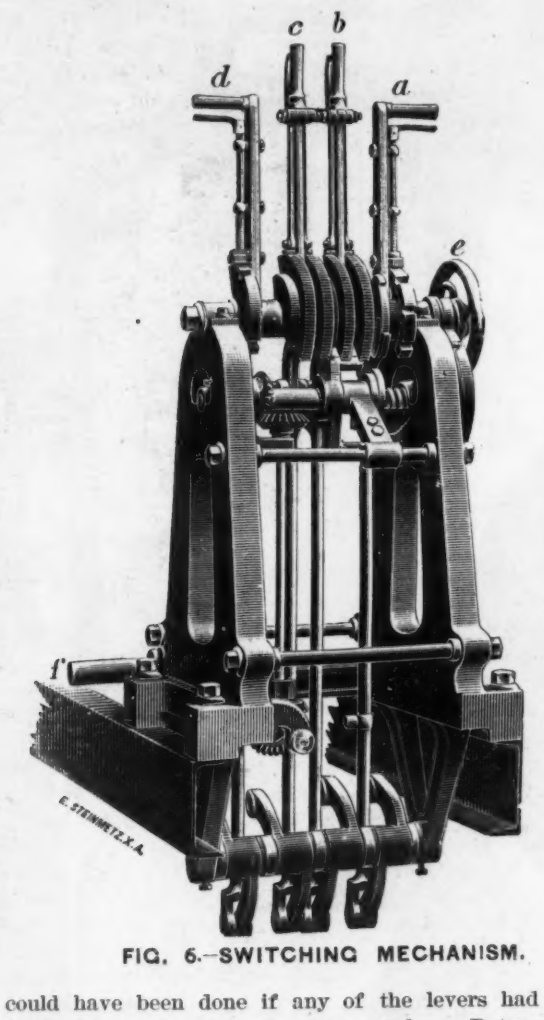


FIG. 6.—SWITCHING MECHANISM.

could have been done if any of the levers had been handled wrongly, or in the wrong order. But now we cannot go on with lever a before having moved the hand wheel c; that is, we cannot switch the dynamo into the circuit before it has been loaded. By moving lever a to the first slot we had not only excited the alternator, but also connected its armature to a load resistance; and now, by moving the hand wheel, we introduce one after the other of these resistances, each of which consumes 5 amperes at 2,000 volts. When at last both alternators and exciters show equal loads, and at the same time equal voltage, lever d is placed in the last notch, thus placing the two exciters in parallel. This being done, the alternators are brought to the same phase, by the usual synchronizers, then lever a is moved into its second position, and the two alternators are in parallel, No. 1 working upon the network alone, No. 2 upon load resistance and network in parallel. At this moment the interlocking arrangement once more hinders any great mistake being made, as a lever cannot be moved on to its third position, when both dynamos are working upon the network alone, before the load resistance has slowly been taken away by turning the hand wheel.

The levers b and c are connected to resistance bases, which at the lower end bear contacts, by means of which the parallel coupling of the compound exciters is effected in the manner suggested by Mr. Guelcher; the levers a and d work the three double mercury switches (Fig. 5), of which one closes the circuit of the alternator's field, while the second connects the circuit of the load resistance, and the third the circuit of the network to the alternator's armature.

These lever locking switches, of which there is one for every dynamo, together with the columns containing two amperemeters for the main, continuous and alternating currents, and one continuous current voltmeter, together with two Cardew voltmeters and two large voltmeters and the apparatus for measuring the insulation resistance of the network at any time, are placed upon a platform shown in the figures. In the closed room below this platform all the resistance boxes and mercury switches are placed, and into this room all the wires from the dynamos are led. From each of the dynamos the necessary wires go downward, and, passing through a special channel, which may be inspected at any time, lead to the aforesaid switchroom.

The total cost of the plant was 1,850,000 marks (about $465,000), made up as follows:

For engine and boiler house, chimney and other buildings	365,000	marks
For boilers and steam leads, pipes, pumps, etc.	130,000	"
For steam engines, dynamos, switching and controlling instruments	645,000	"
For network and transformers	620,000	"
For meters	40,000	"
For preparatory work, inspection during erection, etc.	50,000	"
Total	1,850,000	marks

In the rules of the central station for house wiring the principal points are the following:

The working pressure is 72 or 110 volts; for the calculation of the wires a 16-c. p., 72-volt lamp is assumed to take 1 ampere. The total loss from the transformer to the last lamp, when all the lamps are burning, shall

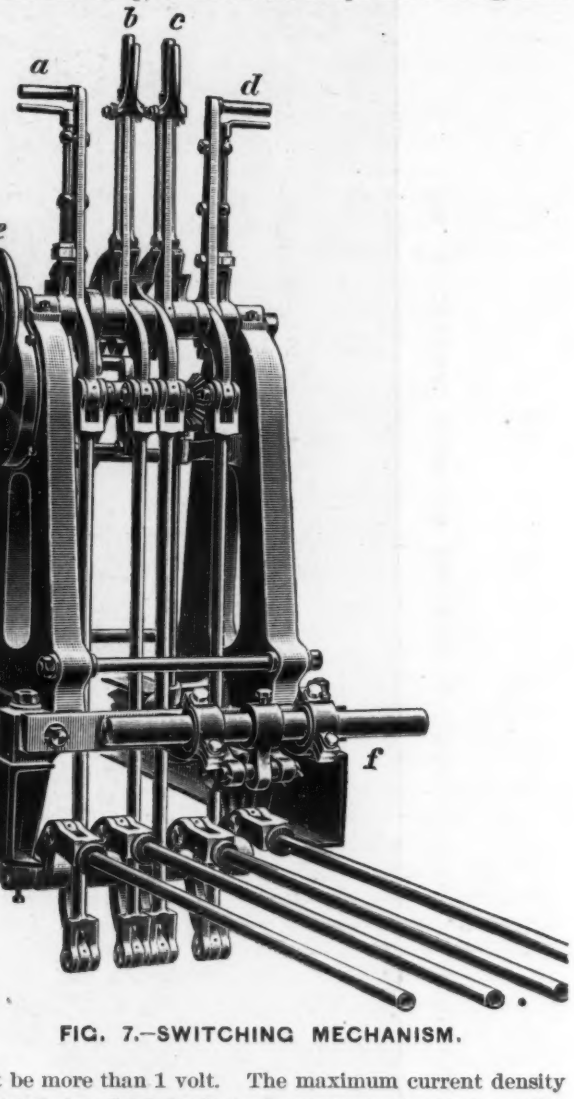


FIG. 7.—SWITCHING MECHANISM.

not be more than 1 volt. The maximum current density allowed for short leads is 2 amperes per square millimetre (1,300 amperes per square inch). Before a plant will be connected to the network—which is done by the municipality—the official engineers test the plant, the lowest admissible insulation being $1 \div c$ megohms, when the total plant takes c amperes. The fees paid for this test are shown in Fig. 2, and it may be seen that they increase with the increasing number of lamps, but decrease when evaluated per lamp, as the total number of lamps increases.

The total number of incandescent lamps connected, assuming 10 incandescent lamps to be equivalent to 1 arc, was about 13,000 in August.

The St. Louis Electrical Club.

The St. Louis Electrical Club, which completed its organization and received its charter late last fall, starts out the new year with the brightest of prospects and a membership of ninety. It has opened elegant quarters in the Equitable Building, at the corner of Sixth and Lucust streets.

The two rooms to be occupied by the club are on the second floor, and have been fitted up in a very handsome and expensive manner, and will compare favorably with anything of the kind in the country. The larger of the two, 60×40 feet, is located on the corner, thus giving light and ventilation on two sides. This will be used as a general lounging, reading and reception room. The other, though somewhat smaller, is of ample dimensions, and has been set apart as a billiard and smoking room. Both are heated by steam and decorated as well as lighted by incandescent lamps.

The St. Louis Electrical Club is proud of its handsome quarters and feels that it will have no cause for apologies when it entertains its colleagues from abroad during the convention of the National Electric Light Association next February.

The Teaching of Science in Schools.*

BY HENRY CUNYNGHAME.

One of the most striking characteristics of our modern system of education is what is known in public schools as the "modern side." The middle and elementary schools may be described as having nothing but a modern side. With the growth of the modern side has sprung up what is termed the teaching of science. The name science is usually reserved for chemistry, physics, physiology, biology and botany, which have been introduced gradually into all our schools with a view, as it is thought, of affording a logical mental training on the one hand and of being practically useful on the other. Against these sciences, when properly taught, there is, of course, nothing to be said. Against the present mode of teaching, then, there is very much to be said. The burdened rate-payer, who feels that the zeal of the school board has almost eaten him up, who sees his rates increase, but without any apparent increase in the capacity of the men who come to mend and bungle over his drains, his roof and his waterpipes, may well be pardoned if he sometimes feels tempted to doubt the efficiency of our boasted school system, and to say of science that we could do without it. The puzzled mother, whose daughters come home from the board schools with their heads full, not of sewing or cookery, but of skeletons and human anatomy, has long ago given up in despair the attempt to understand what objects our modern education has been attempting to achieve, and contents herself with the remark that it is all very wonderful, but she does not understand it. The truth is, that no one can understand it, and the more he learns and knows the more incomprehensible it all appears.

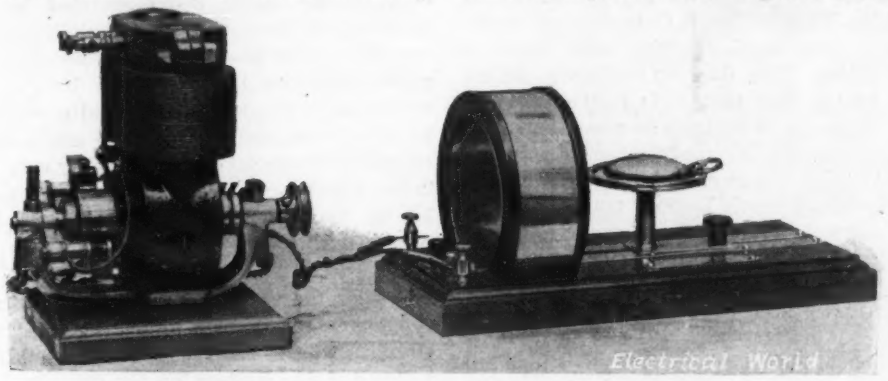
If there is one maxim in education more certain than another, it is this, that what is learned should be learned thoroughly and intelligently, and that ill-digested knowledge is useless, nay, positively detrimental to the intellect. And yet it is not too much to say that our present methods of teaching physics to the young entirely violate this maxim. If any one wished that his boy should attain a competent knowledge of physics, he would, of course, ground him in the three R's of science, namely, geometry, algebra and trigonometry. Without these very little progress can be made. How much of the pages of "The Electrician" could be understood by one ignorant of them? Nay, more, how much could be understood of the simplest mechanical newspaper? And yet, increditable as it may appear, the money, the time and the energies of the school board teachers are being at present spent, not in preparing a modest, yet firm, foundation upon which a future knowledge of science can be raised, but in going through a jargon of science primers, literally building in the air, without any foundation at all. It is, of course, a pretty experiment to show a class the Leyden jar, and the attractions of some pith pills. As they become more advanced, the magic word "potential" is introduced and a sort of pretence made at giving them some notions of "energy," but what a farce the system is when considered as a mental training. And how deplorable, nay, tragic, the farce becomes when we reflect that the money and time are being wasted which might have been used in equipping the boys with the machinery by which they might easily master these things for themselves. The whole system is precisely like the curriculum of the ladies' finishing schools, in which were taught flower painting in water colors, and the use of the globes. And what is the result? That after a certain number of years of misspent time, our young workman, or, as he is now termed, young gentleman, comes from his board school with the airs of a monkey who has seen the world, but without the monkey's mother-wit and intelligence. His mind, exercised in being made to pretend to understand things, but always being taught to evade the difficulties, becomes apish, effeminate, and unfit to cope with the difficulties of life.

A distinguished professor of science, whose name, were I to mention it, would be familiar to all readers of "The Electrician," declared to me that with a few exceptions his whole class consisted of a set of self-satisfied prigs—and these exceptions were the young men who had been brought up on the classical side. And no wonder. In classics a boy at least acquires habits of careful thought and accurate expression, while the wretched untrained student of our modern text-books, in which whole branches of study have to be compressed so as to sell for 3s. 6d., never even comes in contact with a mental problem.

Let any one take up one of these text-books. Let us select one of the very best of them, written by a man who, in point of knowledge, is probably the highest authority in England on the history of his subject—let us take Prof. Silvanus Thompson's "Electricity and Magnetism." Imagine an unfortunate reader, ignorant of mathematics, trying to get through this book. He commences with attractions of pith balls, induction, Holtz machine, and is introduced to that interesting animal, the electric eel. This in 70 pages. He next commences magnetism, and gets on pretty well till he comes to the law of magnetic force, which varies as the inverse square of the distance. If he is fortunate enough to know what the word inverse means, he, perhaps, surmounts this, but two pages further on finds himself entangled in the method of oscillations, and informed that he is to take it for granted that the square of the number of vibrations of a pendulum made in a given time is proportional to the accelerating force acting in the pendulum. Having a few pages further on reduced his mind to confusion by the introduction of some trigonometry, the professor's heart softens, and, filled with compunction, he proceeds in a small printed note to explain what a sine and a tangent are. The reader then passes to a description of batteries, which is fairly comprehensible, but soon all hope must desert him, for in a moment, in the brief space of three pages, he finds himself struggling with the theory that the force of the current i acting on a magnet pole m at a distance r is equal to 2π r m dynes. If he looks out "dynes" in the index he finds it is explained at p. 208, and now let him follow the professor, if he can. Unless he has had a preliminary training in dynamos he cannot, and no wonder. Can the problems which puzzled Galileo, and which were even left half solved by Newton, be comprehended by a reader with the help of two pages of small print in a note? We pass over the fact that when treating of water electrolysis chemical symbols are introduced and manipulated (another slight difficulty), and that knowledge is presumed of atomic weights and chemical equivalents of Dalton's laws. These are merely by the way. The real difficulty is now to commence, for we are at p. 194 introduced to "potential." From that time forth the reader who is not fairly well versed in mathematics had better close the book.

The above remarks are not intended as anything but complimentary of this excellent work, but it is nothing less than a farce that in a book of such difficulty the writer should be obliged to pause and give his reader some notion of trigonometry. It shows that he knew that it was to be read by those ignorant of mathematics, and who were miserably cramming, or, rather, being crammed, to go through some grant-earning or prize-getting examination. It is time that there should be some plain speaking upon this subject. The professors and teachers know the truth. It is time that the public knew it also. It is time that smatterings of astronomy without geometry, smatterings of electricity without algebra, and smatterings of light, sound, and heat, without a knowledge even of the laws of harmonics, should cease, and that parents and school board members should know that in sending boys to learn those subjects without the necessary equipment of mathematical knowledge, they are wasting the time and muddling brains of those to whose abilities we must trust for the future greatness of England. The amount of mathematics required for elementary physics is not large, and could be acquired without any very great difficulty. As a rate-payer, I have no objection to contribute to teach the sons of other people geometry, mathematics and trigonometry and mechanics. When they have learned them I have no objection to contribute to teach them the physical sciences, but I have an objection, and believe that others share it, to seeing my hard-earned money wasted in a manner that would disgrace a fashionable ladies' school, and that is calculated to produce a set of scientific dilettanti, not an educated class of artisans and engineers.

* The *Electrician* (London).



THE LA BOITEAUX WATCH DEMAGNETIZER.

The La Boiteaux Watch Demagnetizer.

In these days of electric railroads and all but universal application of electricity, and the ever increasing army of electrical artisans, the jewelers have had to introduce a new feature into their business, viz.; the demagnetization of watches.

The accompanying illustration, together with the description, will enable our readers to understand a simple device recently introduced for the purpose.

The watch demagnetizer proper consists of a baseboard about 18 inches long and 10 inches wide. In the centre of one end of this, with its plane perpendicular to the board, and its axis parallel to its greater length, is placed a large hollow helix or solenoid. Situated longitudinally in the centre of the board, and extending nearly its whole length, and into the solenoid, is a slot on one side of which is a rack. Traveling in this slot is a carriage supporting an upright shaft, the lower end of which is provided with a pinion which engages in the rack, and the upper end of which supports a horizontal brass ring some 2½ inches in diameter. Over this is stretched a piece of chamois or buckskin. This latter serves as a receptable for the magnetized watch, and is of such a height as to bring the watch in the exact centre of the solenoid when the carriage is pushed to the extreme end of the board.

To furnish an alternating current for the solenoid, use is made of a small ⅛-h. p. electric motor, of peculiar design, and this is a veritable *multum in parvo* that jewelers will appreciate. This motor is an ordinary shunt machine, wound for 110 volts, and thus far does not differ from those with which we are familiar, but the armature shaft is produced at the end opposite to the commutator, and at its extreme end is located a small pulley. Between the pulley and the journal are two insulated metallic rings revolving with the shaft. One of these is connected with one segment of the commutator, and the other with a segment diametrically opposite. Bearing on each of these rings is a brush which connects through binding screws with the solenoid of the demagnetizing apparatus, and from which it can at any time be disconnected. When the two machines are connected up, the demagnetizing solenoid is a shunt to the armature circuit, and in parallel with the field coils of the motor, but as the current in the solenoid comes from diametrically opposite segments of the motor commutator, which are continually revolving, each coming under the positive and negative brush everytime the armature revolves, this current is alternating in character and produces within the solenoid a magnetic field of constantly changing polarity.

It is not necessary to disconnect or stop other work when the demagnetizer is connected up, for, being in paralllel, the two operations may proceed simultaneously with no greater mutual disturbance than an incandescent light experiences when a second on the same circuit is turned up.

The method of operating the demagnetizer is this: Assuming the motor to be in motion, and the two instruments connected up, the carriage is drawn to the end furthest from the solenoid and the magnetized watch placed upon the buckskin. The carriage is then pushed slowly along the slot until the watch has reached the centre of the solenoid, and then it is slowly withdrawn to its first position. As the carriage is moved toward the solenoid, the rack and pinion arrangement causes the vertical shaft supporting the watch and its receptacle to revolve rapidly from left to right. As it is withdrawn the direction of rotation is reversed. One approach and withdrawal, taking, perhaps, two seconds, is sufficient to cure a most obstinate case of polarity in a watch, but it does no harm to repeat the operation.

To illustrate the efficiency of the apparatus, Mr. La Boiteaux removed his own watch from his pocket and deliberately placed it against the pole pieces of a powerful electro-magnet. Approaching his watch to a compass needle, its strong attraction for the latter attested the fact that it was strongly magnetized—ruined, most people would have said. He then placed it on the buckskin receptacle and went through the operation above described, and on approaching it again to the compass needle, it was entirely neutral and no deviation of the needle was observable whatever.

The Incandescent Lamp Situation.

The Edison Electric Light Company secured on Jan. 6 injunctions against the Mather Electric Company and the Perkins Electric Lamp Company. Both of these injunctions are of more than usual interest, as they differ in certain respects from those already granted.

The injunction against the Mather Electric Company is exactly the same as that recently granted against the Sawyer-Man company except in one particular. It will be remembered that in that injunction the right was reserved to the defendant "to move hereafter for the vacation, suspension or modification of the injunction upon proof of specific instances of refusal on the part of the complainants, or either of them, to supply lamps of the patent on reasonable terms under the conditions of the particular case to the owners of electric lighting plants which were installed before the rendition of the interlocutory decree of the Circuit Court sustaining the validity of the patent." It will be noticed

that it is not specified here that the electric lighting plants shall consist of apparatus manufactured by the defendant, although this is undoubtedly the meaning of the text. We are informed that Judge Shipman intended to convey that meaning, and when his attention was called to the point modified the injunction against the Mather Electric Company so as to read, "To the owners of electric lighting apparatus made by the Mather Electric Company which was installed or purchased before the rendition of the interlocutory decree of the Circuit Court, etc."

The decision of the Edison Electric Light Company *et al. vs.* the Mather Electric Company *et al.*, in equity, in the U. S. Circuit Court, District of Connecticut, Judge N. Shipman presiding, is as follows:

On the bill of complaint in the above-entitled cause and the affidavits filed by the complainants therein, and upon hearing counsel for the complainants and defendants therein, it is ordered;

That the defendants, and each and every one of them, and their and each of their clerks, attorneys, servants, agents, officers and workmen, be and are hereby enjoined and restrained, until the final hearing of this cause and the further order of this Court, from making, using or vending any incandescent electric lamps embodying or containing any of the inventions shown or described in letters patent of the United States No. 223,898, to Thomas A. Edison and claimed in the second claim thereof, and from shipping and distributing to others such lamps, and in particular from making, using, shipping or distributing to others any lamps substantially the same in construction and mode of operation as the "Complainant's Exhibits defendant's lamps Nos. 1, 2, 3 and 4," referred to in complainant's moving papers, and particularly described in the affidavit of Henry K. Marvell, forming part of said papers; with leave to the defendants to move hereafter for the vacation, suspension or modification of the injunction upon proof of specific instances of refusal on the part of the complainants or either of them to supply the lamps of the patent upon terms reasonable under the circumstances of the particular case, to the owners of electric lighting apparatus made by the Mather Electric Company, which was installed or purchased before the rendition of the interlocutory decree of the Circuit Court for the Southern District of New York, namely, July 14, 1891, sustaining the validity of the patent, for use with such apparatus.

The decision of the Edison Electric Light Company *et al. vs.* The Perkins Electric Lamp Company *et al.* in equity, in the same court and before the same judge, is also given in full below. This decision materially differs from the others in the fact that it is unqualified, and the right is not given to the defendants to move hereafter for the vacation, suspension or modification of the injunction. The injunction was granted in this form on the ground that the Perkins Electric Lamp Company manufactured only incandescent lamps and no form of electrical apparatus which depended upon the sale of such lamps, and therefore an injunction against it could not be held to damage its business in any other department. This decision is of interest as indicating the course which will be pursued by the courts in future injunction suits which are brought against manufacturers whose sole business is the making of incandescent lamps. The text of the decision is as follows:

On the bill of complaint in the above-entitled cause and the affidavits filed by the complaints therein, and upon hearing counsel for the complainants and defendants therein, it is ordered;

That the defendants and each and every of them, and their and each of their clerks, attorneys, servants, agents, officers and workmen, be and are hereby enjoined and restrained until the final hearing of this cause and the further order of this Court from making, using or vending any incandescent electric lamps embodying or containing any of the inventions shown or described in letters patent of the United States No. 223,898 to Thomas A. Edison and claimed in the second claim thereof, and from shipping and distributing to others such lamps, and in particular from making, using, vending, shipping or distributing to others any lamps substantially the same in construction and mode of operation as the "Complainants Exhibits defendant's lamps" Nos. 1, 2, 3 and 4, referred to in complainant's moving papers, and particularly described in the affidavit of Henry K. Marvell, forming a part of said papers.

Indorsed:

No. 737. U. S. Circuit Court, District of Conn. Edison Electric Light Co. *et al.* vs. Perkins Electric Light Co. *et al.* Decree for injunction filed Jan 6, 1893. E. E. Marvin, Clerk. [Copy.]

Electricity at the World's Fair.

THE POLICE AND FIRE ALARM AND TELEPHONE SYSTEMS AT THE COLUMBIAN EXPOSITION.

On account of the inflammable nature of the Exposition buildings, which their rapid and hasty construction made unavoidable, and on account of the great cost, both of the buildings and their contents, it was early found that to economically decrease insurance rates a most thorough system of fire protection would be necessary throughout the entire grounds. And, furthermore, on account again of the magnitude of the work on the grounds and the number of men employed, and also to amplify the scheme of fire protection, a system of police service equally as complete as the fire protection system was found necessary. By no means the least factor of these protective systems is the police and fire alarm telegraph.

The central station of both the Police and Fire Departments is located at the south end of the "Service Building," which lies between the Horticulture and Transportation buildings, about in the centre of the grounds on the west side.

There are six circuits of both the police and fire systems, and the two are run practically parallel throughout the grounds. As far as possible the alarm boxes are located beside the main entrance of the buildings, the police boxes, which are blue, being placed universally on the right of the entrance, as one approaches it, and the fire boxes, which are red, on the left. In many cases, however, there are boxes located on poles on the grounds, and there are also others at prominent points outside of many of the large buildings.

The six circuits of the alarms are so arranged that they overlap in such a way that should any box, or even an entire circuit, be out of order, one will, by going to the next nearest box, strike an entirely new circuit.

The wires of the alarm system are run entirely under ground. The subway is used to a certain extent, but on account of the varied location of the boxes it cannot be used in all cases. The wires are run chiefly in ducts of wooden "pump-log" of two-inch bore, as many as twenty-one wires being in some cases threaded into one duct.

Each line of the police alarm comprises two wires run entirely around the circuit. The line being composed of a "red" and "black" wire twisted together. The boxes are put in series on the red wire, with a connection through the box to the "black" wire. It would be possible to use the ground instead of the black wire, but the latter insures more positive results, since both wires on each circuit terminate at each end in the central station; each box is in double communication with the office, that is, over either end of the circuit. There is in each police box, besides the regular alarm which rings up the box number, a telephone, by which the patrolman can call up the central station, and by the double connection two phones on any one circuit may be in use at once. The police alarm is also arranged with an automatic index, so that several calls may be made from any box; that is, the alarm may be made to indicate the kind of accident or disturbance. The police boxes and alarms are furnished by the Police Telephone and Signal Company under contract, by which they lease to the Exposition Company, for a term ending Dec. 31, 1893, all necessary boxes, with the accompanying station apparatus, the Exposition Company to do all installation.

The fire alarm circuits have but a single wire, terminating at each end at the central apparatus. The boxes are in series on the circuit, which has a constant current over it, the alarm being sounded by the automatic breaking of the circuit by the clockwork mechanism in the box. The fire boxes are constructed with a small glass cover over the key to the box, so that it is only necessary to break this glass and open the box in order to turn in the alarm. The fire alarm boxes contain no telephone or special alarms, it being only possible to turn in the number of the box. The fire boxes are furnished by the Gamewell Fire Alarm Telegraph Company, of New York, under the same terms as are the police boxes.

Besides the regular fire and police circuits there is a supplementary system, known as the " gong and joker circuit," which connects the central station with all the police and fire stations on the grounds. There are two of these circuits, one north and the other south of the central station. They automatically repeat in the station houses any alarm that may be sent over either police or fire systems The circuit comprises the "gong," which is the ordinary alarm, an automatic register and the "joker," which is a supplementary alarm Telephones are placed in this circuit, by which the stations are placed in communication with one another. Five wires are thus required for this circuit, one for the "gong" and two each for the register and "joker," and all alarms are repeated over each of these, so that it is sure to be received, even though one of the three be out of order.

All wire used for the police and fire alarms is No. 14 B. & S. wire, insulated with thick Para rubber and a mechanical protection of heavy braid. This wire is furnished by the Safety Insulated Wire Cable Company, of New York, and has been found in one instance to give no appreciable ground under six inches of water.

A temporary system for the fire and police alarm was installed early last spring. The boxes were put as near as possible to the permanent locations, and the wiring was by pole lines. The temporary lines are now being rapidly replaced, however, by the permanent connections. An entire circuit of the permanent wiring is put in, and the boxes are transferred one by one in such a way that not more than one box is out of service at one time. Naturally, there are more boxes on the permanent lines, and there were but two circuits from the central office on the temporary lines, but this does not prevent the method of transferal used.

There are two telephone systems on the grounds, one being simply a branch of and under control of the Chicago City Telephone Company. All of the public 'phones on the grounds, however, have a metallic circuit, and there is a metallic trunk line to the city for every seven subscribers.

The other telephone system is under the control of the Exposition company, and is limited in its service to communication within the grounds, having no connection with the city exchange. The 'phones on this "private" exchange have also metallic circuits.

In laying out the wiring for the telephones, large cables are run from the main station to various centres about the grounds; the cables then divide into smaller ones, which are run out and branched to the instruments. Cables containing about 20 or 25 per cent. more wires than are necessary at the time of laying are used, as a rule, so that additional instruments may be connected up quickly and without trouble. Some of the cables contain as many as fifty-two pairs of wires, and there are five main cables from the "private" line switchboard. The telephone cables will be run chiefly on the elevated railroad structure, though the underground ducts will be extensively used.

The installation of the fire and police alarms and the "private" telephone lines is under the direct control of the Electrical Department, Mr. Frederick Sargent mechanical and electrical engineer. The alarm boxes were located by the fire and police department, but all connections are by Mr. Locke Etheridge, of the Electrical Department, the engineer in charge of this installation.

Jackson Park is now one vast warehouse, toward which every railroad and steamship system in the world is bringing exhibits for the World's Fair. It is expected that March 1st will find a large portion of the exhibits in Chicago, excepting those intended for the Horticultural Department.

Foreign nations have been the earliest on the grounds. The early arrivals of exhibits from abroad may be accounted for on the theory that most of the foreign commissioners are experts in exposition matters.

Dr. J. Allan Hornsby, who since the organization of the Department of Electricity has been its efficient secretary, has recently been promoted to the position of assistant chief of the department under Prof. Barrett. Dr. Hornsby is well qualified for this position, being quite familiar with the duties involved, as he has from the beginning discharged most of them. This appointment gives universal satisfaction among those who have to do with the Department of Electricity.

The Foundations for heavy exhibits are already fairly under way, but have been somewhat delayed by the cold weather. In general this work is much further advanced in the Electricity Building than in any other department.

Major Handy, it is now reported, will not resign to take charge of the official catalogue, but will continue in his old position at the head of the Department of Publicity and Promotion.

Major Washburn, with party of 21 aldermen, left for Washington on Sunday afternoon, to urge Congress to repeal the Sunday-closing act. He takes with him an immense petition signed by private individuals and also a number of memorials passed by Council and other organizations.

At a meeting of the World's Fair Commissioners on Saturday, Jan. 7, the method of applying for power and light, and the prices to be charged for same, were definitely settled and are announced as follows:

How to Make Application.—Exhibitors desiring to contract for service of electricity, steam, compressed air, power for shafting, gas or water, must make application to the chiefs of the departments in which their exhibits are installed. No application will be entertained unless made upon a blank furnished by the chief of department; and when an application has been approved by the director general a contract will be executed on the part of the World's Columbian Exposition by the director of works, if practicable, on the terms set forth in the rules. In no case will service be furnished except under authority of contract in writing, the payments for which shall be made by the applicant to the World's Columbian Exposition at the time of the execution of said contract.

In all cases the supply of power, etc., will begin May 1 and end Oct. 30. It is agreed that a limited quantity will be furnished free. For instance, a certain number of electric lamps will be hung in all the buildings. These are supposed to illuminate the aisles and exhibit spaces. If any exhibitor wants his section more brilliantly illuminated he can get all the lights he wants by paying for them. The same principle applies to power to operate machinery. The exposition company will furnish free of charge enough power to start an unloaded machine. If the exhibitor wants to put the machine to the test of turning out a certain product—in other words, loading it—he must buy the additional power.

The rate for each incandescent electric lamp of 16 c. p., for the period of the Exposition, is $8. The Westinghouse system is used, and wiring, which is done at the expense of the customers, will be under the direction of Mr. Burnham's men. State buildings and national headquarters are to be wired by their own boards on plans approved by the director of works.

The charge for connecting motors with the main supply line varies from $10 to $15, according to the power used. The rates for electric power, after connections have been made, are as follows per horse power:

For one-quarter horse power and less	$20
For more than one-quarter horse power and not exceeding one-half	40
For more than one-half horse power and not exceeding one	75
For more than one horse power and not exceeding two	70
For more than two horse power and not exceeding three	60
For more than three horse power	50

WHAT LIGHT WILL COST.

The charge for electric lamps of 2,000 c. p. is $60. The rate for steam power is $40 per horse power. The rate contemplates continuous service, or power that be demanded at any time at the option of the consumer. Those requiring power for a few hours only each day will be charged at the rate of four cents per horse power per hour. The hours that this extra power will be furnished are to be determined by the chiefs of departments.

Compressed air is more expensive, the rate for that being $60 per horse power for the period of the Exposition and five cents per hour per horse power when used at irregular intervals. Power from shafting is listed at $60 per horse power. The following rates for electric power in Electricity Building were agreed to:

For one quarter horse power and less	$15.00
For more than one-quarter horse power and not exceeding one-half horse power	30.00
More than one half horse power and not exceeding one	50.00
More than one horse power, not exceeding two, per horse power	45.00
More than two horse power and not exceeding three, per horse power	42.50
More than three horse power, per horse power	40.00

An important provision of the rules relating to all kinds

of power is that exhibitors who want to operate their machines but one or two hours a day can do so without paying for power all the time. This was different in the old rules, and many complaints were made in consequence. Under the new order of things, department chiefs fix several hours each day when exhibitors who want to operate their machines can do so. The rate charged for this service is about four cents an hour per horse power.

The International Electrical Congress at Chicago.

The following is a report made to the committee of the Electrical Section of the Royal British Commission for the Chicago Exhibition by a sub-committee, consisting of Profs. Ayrton and S. P. Thompson and Major-General Webber. The memorandum was prepared at the request of Prof. Elisha Gray, Chairman of the Electrical Congress.

The committee think it well to prelude their recommendations by pointing out that the only international electrical congress which has met in the past under governmental appointment and auspices was the International Congress of Electricians, held at Paris in 1881, under the presidency of M. Cochery, Minister of Posts and Telegraphs. This Congress was inaugurated by decrees of the French government, and the French members were appointed officially. It sat during a period of about one month; its expenses were paid under a decree of the republic dated Dec. 6, 1880, and its objects were described as being intended to "fix" "*la langue electrique universelle.*"

It consisted of one president, three vice-presidents, 234 members, 23 officials and secretaries. The delegates represented 28 governments. Although any delegate could elect to assist at any of the meetings, the representatives were divided generally into three sections, namely: First, physicists, chemists, physiologists. Second, telegraphists, telephonists and railway engineers. Third, electricians and engineers occupied in industrial and civil and military applications of electricity. The meetings were classified as follows: First, full meetings of the congress. Second, sectional and sub-sectional meetings. Third, meetings at which members specially appointed read papers on specially selected subjects.

At the meetings of the first-named class all subjects of first importance, including reports and recommendations from sections, were discussed, and resolutions of the Congress were recorded. At the second, discussions were held on various subjects, including the careful discussion of questions arising out of the papers read at the third. At the third, to which the public by invitation were admitted, there was only general discussion, most of the time being allotted to the reading of the papers.

The subjects to be dealt with at the meetings of the first-named class: (*a*) Electrical units, and the means of obtaining international uniformity; (*b*) International telegraphy and telephony; (*c*) Discussion of large questions, such as the employment of electricity for lighting, electro-physiology, protection from lightning.

Of the second-named class: In the first section: Theoretical questions, electrical measurements, atmospheric electricity, terrestrial magnetism, lightning protectors, questions of electro physiology. In the second section: Telegraphs, telephones, batteries and generators, telegraph lines, lightning protectors for land lines and submarine cables, induction and interruption, railway telegraph signalling. In the third section: Industrial application of electricity, lighting, systems of distribution, transmission of power, time signals, automatic registration, electro-metallurgy and application of electricity to chemical processes.

As regards the meetings of the third-named class, events showed that papers of real scientific value were not easily secured, most writers of the first rank preferring to reserve such productions for the societies which especially deal with the respective branches of science. Besides, it was found that in the very nature of a congress more vitality was imported to the proceedings by the promotion of general discussion than by passing most of the time in listening to papers. For, however able they might be, they are naturally—if of real value—prepared more with a view of publicly recording the writer's views than of being merely suggestive.

The committee believes, therefore, that the subjects which they enumerate below are of special interest at the present time, and are likely to bring about a useful interchange of information and possible coincidence of opinion; but that it will require careful previous consideration as to the best way of presenting them to the Congress. With this in their mind, the committee has been led to refer to the work of the Congress at Paris in 1881, and, in connection therewith, to recall an incident which cannot but be gratifying and productive of good feeling at a moment when the great nation then principally concerned is about to undertake a similar task in the interests of electrical science and its applications. It was as follows: At the meeting of the Congress on Sept. 20, 1881, it was proposed by M. Cochery, and unanimously resolved, to suspend the day's proceedings in consequence of the news of the death of President Garfield, in the following terms: "Je pense qu'en présence du deuil qui frappe une nation amie, l'assemblée voudra témoigner sa sympathie profonde en levant immédiatement la séance."

PROPOSED SUBJECTS FOR SHORT AND SUGGESTIVE SPECIAL PAPERS.

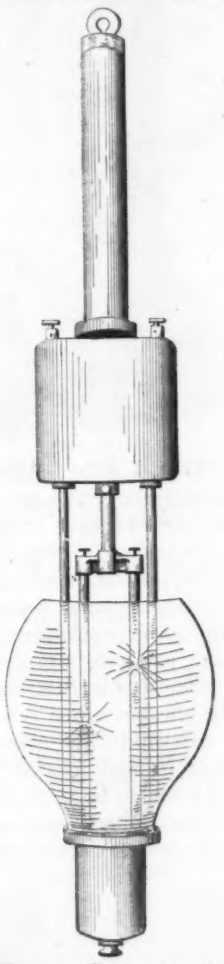
Comparison between procedure in different countries. Methods of avoiding electrical interference, and risks to persons and property. Units of magnetic quantities, and mode of embodying them in concrete standards. The adoption of the name "henry" for the unit of self and mutual induction. Adoption of the "kilowatt" instead of the "horse power" as the unit of power. International nomenclature for describing phenomena of alternate currents and of electromagnetic waves. National and municipal testing laboratories. Materials for standards of electric resistance. Points of difference of the electrical vocabulary used in different countries. The direct conversion of the energy of fuel into electric energy. Comparison of the various methods employed for the electric transmission of power. The cost of insulation in relation to high pressure for the electric transmission of power. Comparison of the economics of the various systems of electric distribution. Alternate current motors. The behavior of transformers when supplying power to alternate current motors. The construction of condensers for alternate current purposes. The measurement of power in polyphase currents. Direct coupled and non-direct coupled dynamos. The use of equalizing dynamos in a three and a five wire system. The use of accumulators in central stations. The proportions between outputs of dynamos, and the weight of copper and iron employed in their construction. Electric traction Application of electric power in mining. The adoption of a uniform method of distinguishing positive and negative mains. Electric supply meters: American, British, Continental. Criterion of sensibility of galvanometers. Commercial instruments for measurement of electric quantities. The relation between the voltage of the arc and the quality and composition of the carbons. The aging of glow lamps. The electric working of metals. The use of electric and magnetic tests for ascertaining the mechanical properties of metals and alloys. The best material and mode of erection of lightning conductors in the light of recent researches in electric discharges. The prospecting for iron by magnetic surveys. International telegraphy. Fast-speed and long-distance telegraphy. The use of batteries or other generators for telegraphy. Telegraphic lines, land and sea. Harmonic telegraphy. Writing telegraphs. Long-distance telephony. The possibility of providing telephonic communication without wires. Application of electric signaling to the working of railways (alarms, time, etc.) and to naval and military purposes. Magnetic separators. The use of electricity in engraving and in art reproductions.

The committee suggest that it would be desirable that a selection should be made as soon as possible, by the American organizers of the Congress, of the actual subjects that it proposed to deal with, so that, even before it is decided who will be requested to prepare the papers, and the order in which they will be taken, the delegates of the several nations may be made acquainted with the selected list of subjects. On receipt of that information the British committee will be prepared, if desired, to suggest names of probable authors, and, if their suggestions be accepted, to arrange with the authors so that the papers may be ready for the Congress. They suggest that a committee for the organization of the Congress shall meet at Chicago immediately before the date decided on for its opening, to arrange, among other matters, for the printing of the papers in full, or in abstract if desirable, and for the preparation of the programmes of daily business.

The Ward Twin Arc Lamp.

BY R. M. HUNTER, M. E.

Your paper of issue Dec. 31, 1892, on page 422, contained an article on arc lamps on incandescent circuits illustrating the Ward lamp. I wish to state that the application of two



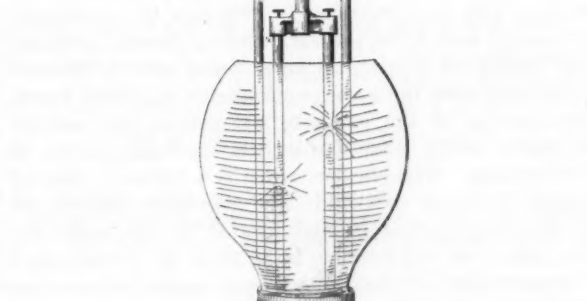
THE HUNTER TWIN ARC LAMP.

arcs in a single arc lamp is set out and fully claimed in an application of mine owned by the General Electric Company. In the lamps I constructed embodying this principle the preferred form employed but a single regulator for both sets of carbons, thus simplifying the lamp to a minimum. The accompanying illustration will give a good general idea of the lamp. While the lower part looks like a twin lamp the upper part is only of the size and style of a single arc lamp

My application describes nine types of this lamp, and the claims fully cover the principle. Aside, therefore, of Ward's not being the first to construct this style of lamp, his construction is far more complicated and expensive than that of mine owned by the General Electric Company.

Diagrammatic Representation of the Efficiencies of Transformers.

The accompanying cut, taken from a paper recently read by Mr. R. V. Picou before the Société des Electriciens, gives a very neat method of showing the various losses in



EFFICIENCY OF TRANSFORMERS.

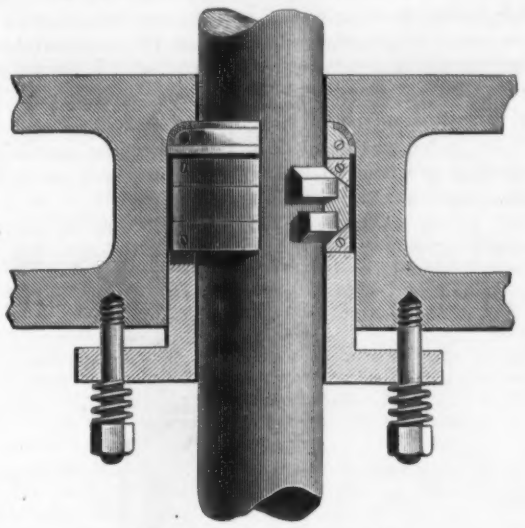
transformers at different outputs. Like most graphical representations, it shows at a glance what it would take tables and paragraphs to describe.

Another Aluminium Factory.

A French company is about to erect a plant at Froges, France, to utilize the falls of the Praz River, giving 2,000 h. p., for the electrolytic manufacture of aluminium.

Forrest's Silver Bronze Rod Packing.

This packing, as shown in the cut, forms a valve at the bottom of the stuffing box, preventing the steam or water from escaping around the outside of the packing, and closes around the rod, preventing leakage from the inside of the packing, the whole packing being held intact on the rod and kept seated by the gland, which is actuated by springs placed on the studs outside of the gland, maintaining a uniform pressure and following up the wear automatically.



SILVER BRONZE PACKING.

The first brass ring in the bottom of the stuffing box is the seat ring; it is put in independently, neatly fitted to the bottom and walls of the stuffing box and grooved out on the bottom to hold the gasket, in which it is imbedded to make it tight.

The next brass ring is ground on to the seat ring, thus making a tight valve joint. This ring is made from one-eighth to one-quarter of an inch smaller in diameter than the stuffing box, to admit of lateral motion without touching the walls of the stuffing box. The rest of the packing, as shown, is of the same outside diameter and free to move in accordance with the vibrations of the rods.

The outside ring next to the gland is the same shape as the bottom ring (valve ring), but does not require to be tight at the gland. This ring slides on the gland laterally in the same manner as the valve ring slides on the seat ring, to accommodate the vibrations of the rod.

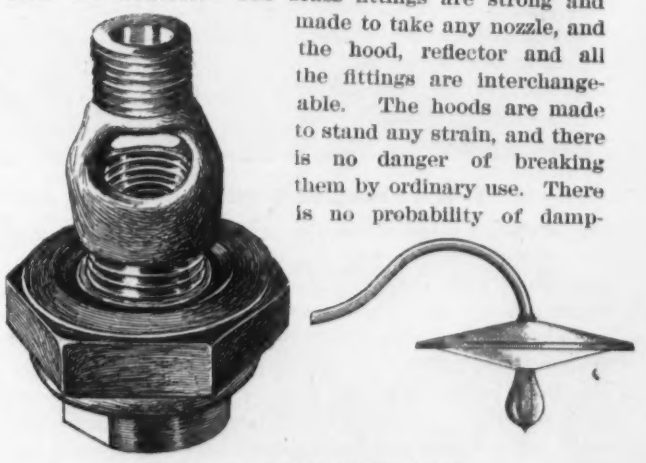
The two inner rings next to the rod are made of silver bronze and take all the wear, and when these rings are worn out they can be renewed, making the packing as good as new without providing any other new parts, as all the rest lasts indefinitely.

The two silver bronze rings are held against the rod by a case made of soft yellow metal. The case and bronze rings are each put in two pieces, placed so as to break joints, are provided with suitable dowels to prevent registering, and may be put in and taken out in less time than any other packing.

The seat, valve and cap rings are screwed together around the rod, and never have to be disturbed to renew the packing.

Marten's Seamless Hood.

The hood shown in the accompanying illustration is very attractive in appearance and durable in construction. Besides being seamless it is thoroughly coated with a special elastic preparation which gives it a highly polished surface. The reflector is also coated with specially prepared white enamel, and the hood and reflector are so adjusted that the receptacle is protected from the weather. The brass fittings are strong and made to take any nozzle, and the hood, reflector and all the fittings are interchangeable. The hoods are made to stand any strain, and there is no danger of breaking them by ordinary use. There is no probability of dampness inside the hood, as is so often the case in other forms. No outside globe is needed, but reflectors are made to fit a protection globe if required. The hoods are made to take wires from the outside or inside as may be desired. This hood is manufactured by the Tea Tray Company, 156-158 Summit street, Newark, N. J.



FIGS. 1 AND 2.—SEAMLESS HOOD.

NEW BOOKS.

QUESTIONS AND ANSWERS ABOUT ELECTRICTY. Edited by E. T. Bubier. 100 pp., illus. New York: D. Van Nostrand & Co. Price 50 cents.

This book, like many others turned out during the present year, contains very little that is new, but perhaps it is hardly right to expect that a book of this character should contain anything more than a restatement of definitions and description of apparatus that to many have already become very familiar. There is, however, a large class of students who will find in this book a brief statement of some of the principles of electricity which they have been unable to find in other books, not because they do not exist in other publications, but because they are frequently buried beneath a great deal of material which students of this class do not care to dig over in order to find the few brief definitions of which they are in search. The book, however, is too small and does not cover the ground as thoroughly as a book should do that—according to its title page—purports to a "first book for students."

THE LAMP LIGHTING SCHEDULE ON THE MOONLIGHT SYSTEM FOR 1893 has been issued by the Western Electric Company of Chicago. It is put up in pamphlet shape, giving moonlight schedule for each month of the year on a separate page, and is sold for 25 cents.

A little pocket handbook of iron and copper wire in electric transmission has been issued by the Washburn & Moen Company of Worcester, Mass. This is the tenth edition of this little pocket-book, and, as a compilation of the facts and figures that constitute the basis of the science and practice of the vatious applications of electricity, will be found extremely convenient for use in electrical and engineering practice.

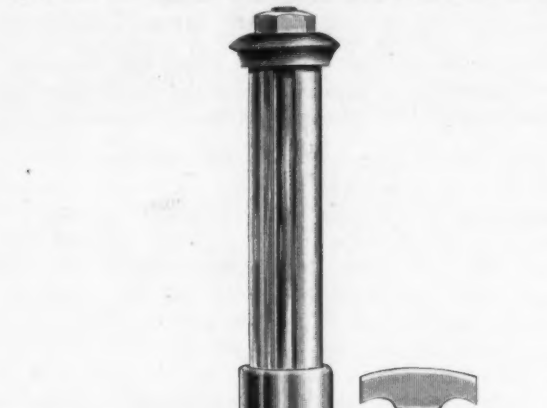
THE TRADESMAN'S ANNUAL for Jan. 1, 1893, has just been issued. This is the fourteenth annual issue brought out by the *Tradesman* of Chattanooga, Tenn. It contains a very elaborate array of valuable statistics, and presents in a very comprehensive and exhaustive way an immense amount of data regarding the industrial development of the South.

INFORMATION ON THE SELECTION AND MANAGEMENT OF MACHINE BELTING is the title of the fifth edition of a little handbook published by the Schultz Belting Company of St. Louis, Mo. It contains useful tables of determining the width of belt and the horse power to be transmitted, together with a number of practical instructions regarding the treatment of beltings.

The Standard Electric Company, of Chicago, has issued a new catalogue which contains descriptions and illustrations of the company's system of arc lighting.

THE MINERAL INDUSTRY: ITS STATISTICS, TECHNOLOGY AND TRADE, is the title of an elaborate work published by the *Engineering and Mining Journal* of this city; this work replaces the usual annual statistical number of the *Mining Journal* and will be found to contain with unusual fullness valuable reports on the mineral industries in the United States and other countries, making the best and most complete reference book on this subject.

LUNKENHEIMER OIL GAUGE.



LUNKENHEIMER OIL GAUGE.

Electric Mine Pumps at Duryea, Pa.

An excellent example of the manner in which electricity is displacing steam in the mining industry is given by the recent installation in the William H. colliery of the Connell Coal Company, located at Duryea, Pa. This colliery is considered one of the most important mines in its district, the average daily output being about 1,200 tons. Many improvements have been made in the plant, which will enable the mine to turn out from 1,400 to 1,500 tons per day.

The feature of greatest interest in the improved plant is the electric pump. This is the first electric pump introduced in the mines of that section, and its successful operation is being watched with great interest by all interested in mining matters. The pump is of the horizontal, triplex or three-plunger style, with 6½-inch plungers and 8-inch stroke. It makes 42 revolutions per minute, and, in its present location, throws a steady, solid stream of water through a 4-inch pipe a distance of 500 feet from the lower workings to the main pump. The capacity of the pump is 500 gallons per minute. Its entire weight, inclusive of the operating motor, is 6,000 pounds. The electric motor is a 7½-h. p. General Electric Company motor, and the generator, constructed by the same company, and located in the main engine house, on the surface, is of 10 h. p. The power is transmitted to the motor over copper wires running down through the air shaft and along the roof of the mine for a distance of 1,700 feet. The pump and motor are mounted upon a wheeled truck, and can thus readily be transported to any point in the workings. This quality alone is a strong recommendation to mine owners. The claim of the General Electric Company that the electric pump needed considerably less attention than the steam pump has been fully admitted by the managers of the colliery.

By the use of the electric pump a great danger in this mine has been obviated. The steam from the steam pump formerly used penetrated the roof of the mine in its vicinity, loosening the rock and rendering the possibility of its fall always imminent.

Besides furnishing power for the pump, the electric generator on the surface supplies current to the incandescent lamps, which light the engine houses, the head of the shaft, the inside pump house and the workings about the foot of the main shaft. The contrast between the incandescent lamps attached to the roof along the main gangway and the illumination sparsely distributed from the ordinary miner's lamp is most striking.

If, after a few months' trial of the new system of lighting and pumping, it is pronounced successful, the colliery company intends still further to utilize electricity in its mine, and put it to other uses, such as to operate drills and locomotives. It is far superior to steam or compressed air for the operation of drills, or to mule, rope or steam haulage for that of locomotives.

The electric period in coal mining is fast advancing, and mine managers and owners of a progressive nature, recognizing this, are vigilantly watching new developments in this direction.

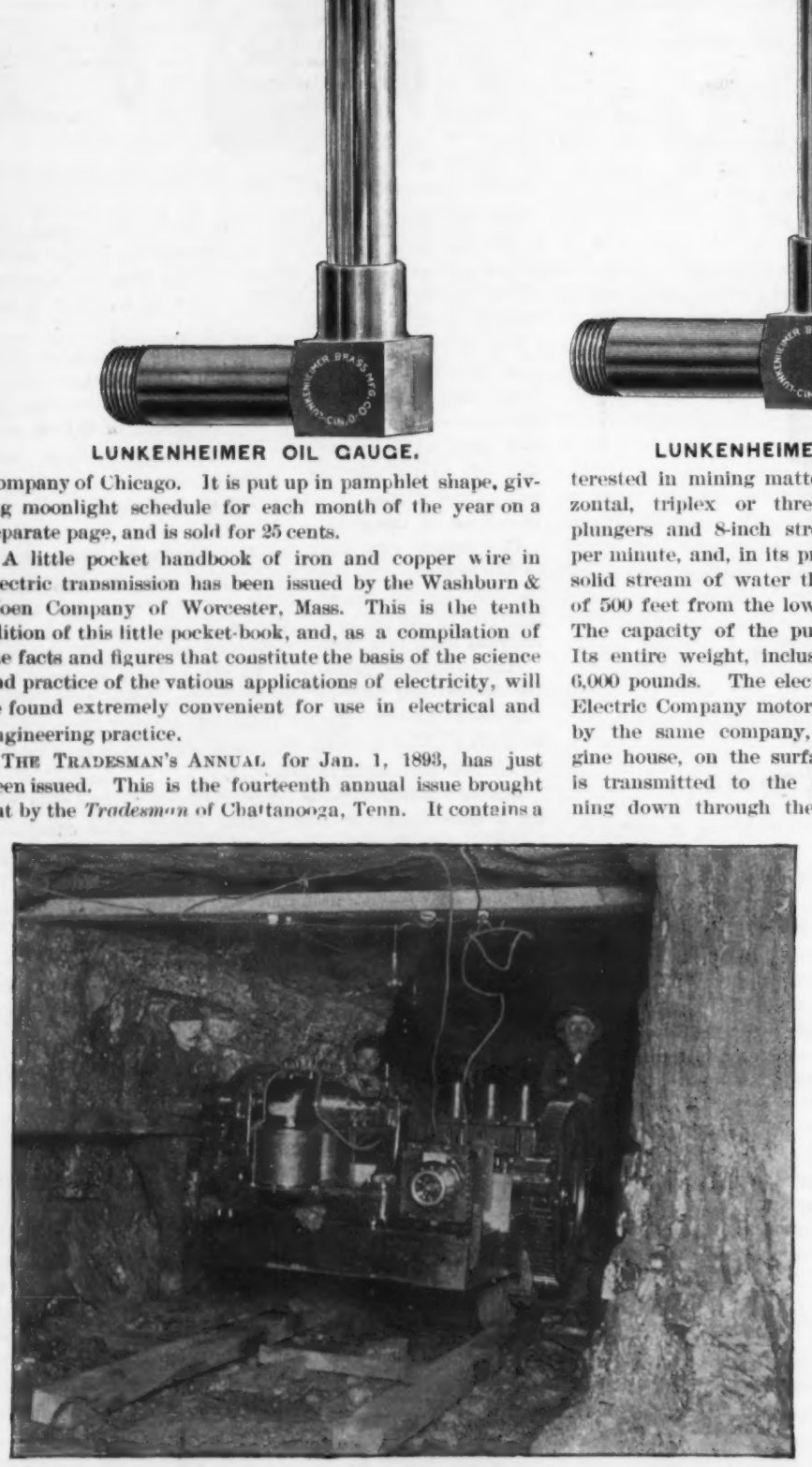


FIG. 1.—ELECTRIC MINING PUMPS AT DURYEA, PA.

FIG. 2.—ELECTRIC MINING PUMPS AT DURYEA, PA.

Lunkenheimer's Improved Oil Gauges.

A good oil gauge is an essential point of the equipment for every plant. The oil gauges shown in the accompanying illustrations are designed especially for dynamo bearings, and will be found to be an improvement over the ordinary forms. They are simple, ornamental and inexpensive, and serve the purpose for which they are intended admirably. As the glass tube is fully exposed to view, the amount of oil in the cups can always be seen at a glance.

THE WHITNEY VOLTMETER.

The Whitney Electrical Instruments.

The accompanying cut represents very clearly the general appearance of the Whitney ammeters and voltmeters, which are being placed on the western market by the Electric Appliance Company. The instruments are of the permanent magnet type, the magnets being "aged" by a special process calculated to make them retain their magnetism constant for an indefinite period. Every instrument is hand calibrated and subjected to the severest possible test before leaving the factory. The voltmeters are intended for both switchboard and testing purposes, and are divided into class "A" for intermittent work and class "B" for continuous work; that is, class "A" are to remain in circuit for short periods only, while class "B" may be kept constantly in circuit.

The instruments are provided with a mechanical dead beat attachment, operated by simply touching a button, and intended to facilitate the taking of rapid readings.

A large and complete stock of these instruments is being carried in Chicago by the Electric Appliance Company.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

[Inquiries from our patrons for information relative to stocks and bonds of the various electric light and power companies are solicited, and will be answered in this column.]

NEW YORK, Jan. 7, 1893.

NEW YORK GENERAL FINANCIAL STOCK MARKET.

The market closed with a better tone and with a net advance in value of from one to three points. The feeling of uncertainty of the past two weeks is giving way to one of more confidence, which will be apt to insure considerable activity, and possibly an advance in values next week. The conditions which brought this about are primary, and are to be found in the improvement of the monetary situation. As we mentioned last week, something like $100,000,000 was released in the form of dividend and interest payments. This has had a most stimulating effect upon speculation. The bank statement shows an increase in surplus reserve of $2,101,900. This on top of a net increase in deposit for the week of $10,778,400 shows that the money, for a time at least, is to be held in this country. Again, at last week's close, it was believed that the gold movement would be very heavy. This was erroneous, inasmuch as total shipments aggregated only $2,000,000. To-day exchange was weak, reflecting easy money and an increase in commercial bills. That some distrust exists in the English mind toward our securities, because of our silver policy, has been mentioned repeatedly in this column, and we cannot otherwise than believe that the improvement noted is but of a temporary nature, and that any permanent change for the better will only be brought about by a repeal of the Sherman silver law. Commercial agencies report every branch of business as looking forward to a year of large transactions. Returns are giving fresh evidence of the prosperity of 1892. The failures for the year were 323, against 435 in 1891. The bank clearances show an increase over the year 1891 of 9.1 per cent. The weak spot in the commercial world just at the present time is the low price of wheat. The causes which have promoted this are too well known to require repetition at this time. Various authorities claim that an improvement is not only in sight, but is near at hand. Last week the price advanced a little upon the showing made by the government crop report that stocks were smaller than expected; a reaction followed upon large receipts at western towns. General satisfaction is expressed in the South over the improved situation. The sugar crop promises 200,000 tons; money is a little easier, and cotton maintains its price. Statisticians' returns show that the cotton in sight last night was 4,712,677 bales, against 6,663,278 bales at the corresponding time last year. The earnings for 52 railroads during the month of December increased 2.43 per cent. This showing is much more favorable when it is considered that the month was attended by very severe weather, while in December, 1891, we experienced an "open winter" climate.

NEW YORK ELECTRICAL STOCK MARKET.

This list of specialties, with scarcely an exception, scored net advances for the week, some of them being very pronounced. The movement was due to two causes. Primarily, to the general improvement in the situation, and, secondarily, to intrinsic merit. It is indeed a queer commentary on the logic of events where the latter is subordinated to the former. However, in this day of money scares, "busted pools," etc., the operator who buys stocks on the margin has been taught to look to the former first. We note the same general inquiry for the high-priced telegraph stocks and the inability of bidders to make purchases. Thus the bid price of Central & South American Telegraph was moved up 5 points to 110, and immediately the asked price advanced 5 points to 120. The asking price of Commercial Cable was advanced to 180 from 177½, while the bid price dropped 3 points to 170.

Western Union.—It has been published that application has been made or would soon be made to list Western Union on the London Stock Exchange. It has been intimated that the application would be made by J. S. Morgan & Co., of London. We asked Mr. Morgan what truth there was in it. He replied: "I do not know that any application has been made to list the stock. I do not think the company has applied for listment. Individuals in London might list the stock if they held enough of it. I do not think over 5,000 shares of the stock are held in London." The range of stock did not vary for the week, being very firmly held at about the opening prices. On Thursday, when the general slump took place, it dropped off to 94⅞, but quickly reacted to 95⅞. The one characteristic of the trading seemed to be a general buying without any definite plan, while insiders, without attempting to put up the stock, lent it strong support in maintenance of current quotations. The bull operators, who were active shortly after Mr. Gould's death, have turned their attention to sugar, and perhaps one or two other industrials, to the neglect of Western Union. Any renewed and pronounced activity may be taken as indicative that they have returned. The collateral trust five bonds were in quite good demand, selling at 103⅛ to 103¾.

General Electric.—This company has declared a quarterly dividend of 2 per cent. on its common stock, payable Feb. 1. Transfer books close Jan. 14 and open Feb. 2. Our remarks in regard to Western Union may be applied in a general way to this security. It led a very quiet week and closed very firm at the highest prices. Two weeks ago it sold at 115, with no dividend in immediate prospect. It is now 112, with a dividend to be placed to its account a week from Monday. Consequently, it is logical to say that the price next week will advance to 114 or 115. An officer of the company states that business has never been better nor made better promise. The various hitches and readjustments always attendant upon the consolidation of extensive capitalized interests are about overcome and the company sees nothing but plain sailing for the future.

Edison Electric Illuminating.—On Thursday the bonds advanced from 111½ to 112⅞, and the stock to 115½. To-day the bonds advanced to 114 bid. Purchasers are people well posted on the affairs of the company, who believe that it has as great a future before it as the local gas companies, whose shares have depreciated over 300 per cent. in the last 10 years. The company's books closed at 3 P. M. on Friday. To-day the stock was in very good demand, and apparently there was very little for sale. This ran the quotation up to 116½, the highest point ever reached, while the closing was 116 bid and 117 asked. There is no longer any doubt but that the buying is very largely for investment.

American District Telegraph.—Quotations were limited in number and were only made at an advance. There was no stock pressed for sale. A great many complaints are now being voiced in the public press against the business operations of this company, but they seem to be without effect. It has a virtual monopoly of the messenger business in the city, and no one appreciates the fact any more than the stockholders.

WALL STREET NOTES.

A Philadelphia dispatch says that Mr. C. B. Wright is reported to have practically concluded the sale of his electric lighting and water-supply plant, at Tacoma, Wash., to the authorities of that city, for $1,850,000, payable in cash or city 5 per cent. bonds.

The street car lines of Philadelphia were given authority this week to use the trolley system.

Three thousand five hundred shares of North American Phonograph sold Thursday at public auction for $7,500.

A sale of considerable interest was made on Thursday. It was of $3,000 of Mutual Union Telegraph Company's five per cent. bonds at $1.13.

The copper market is very quiet and firm. Producers continue to hold at 12½ cents for lake copper, while bidders are offering about 12¼. Sales of a few second hand lots of small amounts were sold at 12.30 cents. There are signs of work aimed to consolidate and solidify the different interests in the copper world, all of which will have a tendency to elevate the price of the metal if brought to a tangible conclusion. The European market continues firm, notwithstanding the increase in the visible supply of stock on Jan. 1, as compared with Dec. 1.

Closing Quotations.—The following were the closing quotations of electric stocks on Saturday, Jan. 7, 1893, and the range for the week in New York:

NEW YORK QUOTATIONS.

	Par.	Capital outstanding.	Lowest.	Highest.	Bid.	Ask'd.
American District Tel....	100	3,825,000	57	58¾	56	58
American Tel. & Cable..	100	14,000,000	85½	87	86	87½
Central & So. Am. Tel....	100	6,500,000	....	....	110	120
Commercial Cables.....	100	7,716,000	....	....	170	180
Gold Stock & Tel.....	100	5,000,000	....	....	100	103
Bonds.....	500	500,000	....	....	100	....
Mexican Telegraph.....	....	2,000,000	....	....	180	200
Northwestern Telegraph.	....	2 500,000	....	....	102	....
Postal Tel. & Cable.....	...	10,000,000	....	....	62	64
Southern & Atlantic Tel..	25	948,775	....	....	78	84
Western Union Tel.....	100	94,820,000	94⅞	96½	95	96½
Real estate bonds.....	1,000	1,219,000	....	....	....	..
Debenture bonds.....	1,000	1,920,000	....	....	....	..
Collateral Trust 5's....	1,000	8,181,000	103½	103¾	....	
North American.....	100	39,767,200	10	10⅜	10⅛	10½
Brush Ill. Co. of N. Y.....	50	1,000,000	....	....	30	60
Edison El. Il. of N. Y.....	100	6,100,000	114¾	116½	114	117
" " 1sts.....	...	.....	112	112¾	...	..
" " Deb's...	...	.....	....	....	...	....
Edison El. Il. of Brooklyn.	100	1,500,000	...	....	106	108
" " " " Chicago..	100	750,000	....	....	130	145
" " " " Boston...	...	.....	....	....	115	125
Edison El. Lt. Europe....	1,000	2,000,000	....	....	2	6
" Bonds.....	....	30,000	....	....	65	80
Edison Ore Milling Co....	...	2,000,000	....	....	15	20
East River El, Light.....	100	1,000,000	....	....	....	65
General Electric.....	1,000	30,395,600	111	113	111⅛	111⅝
Debenture 5's	...	10,000,000	100½	100⅝	....	....
Automatic Exhibition Co.	...	2,500,000	....	....	3	5
Mt. Morris Electric.....	...	500,000	....	....	....	65
N. E. Phonograph.....	...	2,000,000	....	....	2	4
N. Y. Phonograph	...	2,000,000	....	....	2	5
N. American Phonograph ..		2,000,000	....	....		2.25
Westinghouse E. & M. Co. 1st p. 7 per cent., Cum.	50	3,755,700	....	....	....	....
E. & M. Co. Assg.....	50	5,333,940	....	....	....	....

CHICAGO QUOTATIONS.

Following are the quotations of telephone and electric stocks furnished THE ELECTRICAL WORLD by C. V. Banta, Jr., 167 Dearborn street:

Telephone Stocks:	Bid.	Ask'd.	Electrical Stocks:	Bid.	Ask'd.
Chicago.....	....	211½	Chicago Arc Light & Power Co.....	104¼	103
Central Union	57	58	Chicago Edison Co ...	175	....

NEW INCORPORATIONS.

The Havana Electric Company, Havana, Ill., capital stock $30,000, has been formed to erect an electric light and power plant. J. W. Bronson, C. C. Travis and May B. Bronson are the incorporators.

The George E. Lloyd & Co., of Chicago, Ill., capital stock $100,000, has been formed to manufacture and sell electrical machinery, etc. Ed. C. Williams, Josiah Cratty and Wm. B. Jarvis are the incorporators.

The E. C. Stoelting Manufacturing Company, of Chicago, Ill., capital stock $15,000, has been formed to manufacture and deal in electrical instruments, etc., etc. The promoters are as follows: C. H. Stoelting, Wm. Kuhn and A. C. Stoelting.

The Standard Electric Company, of Denver, Colo., capital stock $15,000, has been formed to do a general electrical business in Europe and America. H. A. Priggs, Ernest Woltmann and C. S. Hooper, all of Denver, are the promoters.

The Riverview Iron Works, Bordentown, N. J., capital stock $100,000, has been formed to manufacture electrical machinery and appliances. J. H. Longstreet, Bordentown, N. J.; A Kitson and T. L Carpenter, Philadelphia, Pa., are the organizers.

The General Electric Company, of Santa Fe, N. M., capital stock $100,000, has been formed to do a general electrical business. Jos P. Ord, S. Endicott Fesbody, Frank S. Hastings, Jas. Jackson, S. Dana Green and Eugene Griffin are the incorporators.

The Ohio Construction Company, of Cleveland, O., capital stock $10,000, has been formed to do a general electrical and mechanical business, etc The organizers are B. M. Carr, Robt. M. Fuller, Frank E. Dellenbaugh, Paul B. Huvette and Howard L. Browning.

The Metal Construction and Bridge Company, of Chicago, Ill., capital stock $100,000, has been formed to construct and equip electric and other railways, etc. L. C. Link, Edmund G. Short, Georgiana Dennis, Wm. H. Davis and J. L. Reede are the promoters

The Mayfield Coal Mine Toll Road and Electric Railway Company, Ouray, Colo., capital stock $100,000, has been formed to build an electric railway. R. N. Mayfield, Wm. Story, Fred Hochuli, Abram Humphrey and C. W. Haskins are the promoters.

The New York & Atlanta Construction Company, Jersey City, N. J., capital stock $10,000, has been formed to build construct, sell and lease railways, etc. C. E. Gill, Brooklyn, N. Y.; C. H. Davis, New York City, and F. F. Merceles, Jr., Jersey City, N. J., are the organizers.

The Columbia & Washington Street Railway Company, of Columbia, Pa., capital stock $40,000, has been formed to construct and operate an electric railway in Lancaster County. Andrew J. Kauffman, William Hayes Grier, and Henry C. Young are the promoters.

The Pruyn Company, of Chicago, Ill., capital stock $5,000,000, has been formed to acquire and control patents and rights to construct and equip electric elevated railways, to license others to use the patents, etc., etc. H. S. Pruyn, Alex. W. McClure and H. A. Osborne are the organizers.

The Russell & Officer Electric Construction Company, of Denver, Colo., has been formed to manufacture and sell all kinds of electrical appliances and apparatus for lighting and power. Geo. W. Russell, Jr., Alex. V. Officer, and Fred Robins, all of Denver, are the organizers.

The Light, Heat and Power Company, of Pittsburgh, Pa., capital stock $500,000, has been formed to construct electric railways, telegraphs, cables and other works, to which electricity may be applied. R. S. Waring, C. C. Dickey, and Herman Veider, all of Pittsburgh, are the promoters.

The Law Battery Company, Jersey City, N. J., capital stock $50,000, has been formed to purchase, use, rent and sell electrical and other manufactured articles. The organizers are Charles Shaw, Jersey City, N. J.; Mortimer M. Hayden, New York City, and W. P. Jones, Brooklyn, N. Y.

The Salmon River Power Company, East Haddam, Conn., capital stock $50,000, has been formed to develop and distribute power, including water and electric power, etc. Theodore Tietz, Marlborough, Conn.; C. E. Brownell and Nelson H. Bowers, East Haddam, Conn., are the promoters.

The Petersburg Electric Light, Power and Water Works Company, of Petersburg, Ind., capital stock $10,000, has been formed to furnish electric light and water to the town of Petersburg. Gustoff Frank, Moses Frank, Chas. A. Burger and Willis V. Hargrove are the incorporators.

The Associated Electric Company of New Jersey, of Trenton, N. J., capital stock $20,000, has been formed to erect, maintain, etc., telegraph, electric light and power plants, and lines, etc. A. R. Kuser, J. Wallace Hoff and Philip Freudenmacher, all of Trenton, are the promoters.

The Hancock County Electric Light and Power Company, Peoria, Ill., capital stock $15,000, has been formed to erect and operate an electric light and power plant in Warsaw, and to sell electrical merchandise and apparatus. E. B. Hillman, L. B. Bradley and H. T. Hays are the promoters.

The Clayton Electric Light and Water Supply Company, Clayton, N. M., capital stock $20,000, has been formed to operate a system of electric light and water works. J. C. Hill, E. W. Fox, S. I. North, G. A. Bushnell, R. P. Ervien, W. W. Boyle, J. B. Herron and H. C. Pickles are the promoters.

The Denver, Mount Olivet & Golden Railway Company, of Denver, Colo., capital stock $125,000, has been formed to build, operate and maintain an electric railway from Denver to Golden, Colo. The organizers are C. E. Talmage, Daniel Sayer, Denver; Jerry Coulehan and Chas. R. Fish.

Moyamensing & Penrose Ferry Road Passenger Railway Company, Philadelphia, Pa., capital stock $25,000, has been formed to construct and operate an electric railway in Philadelphia, Pa. Jos. M. Hewlett, James Morrow, and J. Clayton Erb, all of Philadelphia, are the promoters.

The Worcester Traction Company, of Newark, N. J., capital stock $5,000,000, has been formed to maintain and operate electric lighting, heating and other business. E. E. Denniston, E. J. Moore, C. F. Stevens, Philadelphia; T. C. Barr, Newark, N. J., and S. F. Hass, Chester, Pa., are the promoters.

The Malone Light, Heat, Power and Coal Company, Malone, N. Y., capital stock $50,000, has been formed by the consolidation of the Malone Gas Company and Malone Electric Light and Power Company. Sam A. Beman, Orin S. Lawrence, and Nelson W. Porter, all of Malone, are the incorporators.

The Juniata Valley Electric Railway Company, Bellwood, Pa., capital stock $100,000, has been formed to construct and operate an electric railway from Altoona through Bellwood and Tyrone, with branches. E. B. Kay, C. K. Ford and C. H. Montgomery, all of Bellwood, Pa., are the organizers.

The Mason Electric Company, of East Orange, N. J., capital stock $500,000, has been formed to manufacture and deal in electrical goods, etc. J. H. Mason, Brooklyn, N. Y.; T. S. Carman, J. E. Van Doren, A. F. Richardson, New York City, and F. F. Raymond, of East Orange, are the parties interested.

The Electric and Gas Fixture Company, of Portland, Ore., capital stock $25,000, has been formed to carry on the business of buying, selling and dealing in electrical and gas fixtures and appliances for lighting, heat and power. W. F. Hall, J. A. Cranston and Frederick V. Holman, of Portland, are the promoters.

The Hawks Electric Company, of Boston, Mass., capital stock $12,000, has been formed to purchase and sell electrical apparatus, etc., and to furnish electricity for light, heat and power, etc. Horatio C. Hawks, 620 Atlantic avenue, and Wm. S. Wells, 83 Milk street, Boston, Mass., and James W. Magee are the promoters.

The Jonesboro Power Company, Jonesboro, Ark., capital stock $7,000, has been formed to operate an electric light and ice plant in Jonesboro, and also a system of waterworks. G. W. Decker, Newport; W. L. Arnnod, St. Louis, Mo.; N. F. Lamb, S. A. Warner, Jr., and J. C. Hawthorn, all three of Jonesboro, are the promoters.

The Denver & Westminster Railway Company, of Denver, Colo., capital stock $1,000,000, has been formed to build a railroad to be operated by electric or other means. David R. C. Brown, Jas. M. Downing, of Aspen; Rodger M. Woodbury, Henry J. Mayham, and Michael Benedict, of Denver, Colo., are the promoters.

The Electric Revolving Display Manufacturing Company, of Portsmouth, N. H., capital stock $5,000, has been formed to manufacture and sell electric goods and devices, especially of electric revolving display stands. Wm. M. Glidden, Albert B. Grimes, Geo. W. Tebbetts, Hayes Longee and Daniel A. Glidden are the promoters.

The Ambler Electric Light, Heat and Motor Company, Ambler, Pa., capital stock $15,000, has been formed to manufacture and supply heat, light and power. H. G. Keasbey, Thos. Rose, both of Ambler; R. V. Mattison, Upper Dublin; G. R. Wallace, Fort Washington, and Wm. McDaniel, Jr., Philadelphia, are the incorporators.

The Union Street Railway Company, Santa Rosa, Cal., capital stock $50,000, has been formed to construct and operate a street railway propelled by electricity or other means. B. M. Spencer, H. G. Hahmann, Guy E. Grosse, L. Burbank, B. Hottinger, J. S. Taylor and C. F. Juilliard, all of Santa Rosa, are interested in this organization.

The International Carpenter Electric Heating Manufacturing Company, St. Paul, Minn., capital stock $400,000, has been incorporated for the manufacture of electric lighting and heating apparatus, dynamos, rheostats, etc., etc. G. H. Finn, J. C. Bullitt, Jr., C. P. Coleman, J. K. Bacon and J. R. McMurran, all of St. Paul, are the promoters.

The Brooklyn Electric Manufacturing Company, of Jersey City, N. J., capital stock $20,000, has been formed to manufacture and deal in electrical specialties, mechanical appliances, machinery, and do a general engineering and contracting business. S. O'Connor, W. S. Barstow, Brooklyn, N. Y., and M. Strong, of Montclair, N. J., are the promoters.

The Pacific Grove, Monterey & Del Monte Electric Railway Company, of San Francisco, Cal., capital stock $250,000, has been formed to construct and operate street railroads. J. T. McCrossen, A Baranard, M. W. Bell, Wm. H. Chapman, G. W. Hopkins, N. C. Carnall, all of San Francisco, and N. H. Bryant, of Pacific Grove, Cal., are the parties interested.

The Chicago General Street Railway Company, Chicago, Ill., capital stock $3,000,000, has been formed to construct and operate horse, electric, cable and dummy railways in Chicago, and to purchase or lease existing lines, etc.; also to construct and operate a heating, lighting and power supply. Lyman M. Paine, H. L. Burnette and Chas. L. Hull are the promoters.

The Excelsior Electric Signal and Manufacturing Company, South Omaha, Neb., has recently entered the field. It is incorporated at $50,000, and is the sole owner of the Cook patents, and deals in danger railway signals, automatic fire alarm and railway car telegraphs, etc. The officers of the company are: W. N. Babcock, president; W. S. King, vice-president; B. E. Wilcox, secretary and treasurer, and W. S. Cook, general manager.

Special Correspondence.

NEW YORK NOTES.

Office of The Electrical World,
167-176 Times Building, New York, Jan. 7, 1893.

Capt. Willard L. Candee, manager of the Okonite Company (Limited), 13 Park Row, New York, sailed Dec. 31, on the North German Lloyd steamship Saale, for London, on business connected with the company.

Mr. M. R. Russell, former editor of the *Telegraph Age*, has purchased the property, outstanding accounts and good will of that journal, and will hereafter, in connection with Mr. J. H. Glover, have entire charge of its publication.

Mr. S. W. Childs, who was formerly identified with Messrs. Barry & McTigh, but more recently with the Atlantic Avenue R. R. of Brooklyn, as superintendent of construction, resigned this position Dec. 31 to take charge of the construction work of Messrs. Barry & McTigh in the West.

The New York Electrical Society will hold its 150th meeting on Wednesday, Jan. 11, 1893, at 8 P. M. at Columbia College, Madison avenue and Forty-ninth street. Mr. Augustus Noll, general superintendent of the New York Electric Equipment Company, will give "A Practical Talk on the Installation of Isolated Electric Lighting Plants." The lecturer will also illustrate the method of calculating the size of conductors by working out an actual example.

Albany, Jan. 7, 1893.

The electric cars in Buffalo are being equipped with electric heaters.

The Schenectady Electric Railway Company contemplates extending its lines.

Cobleskill will soon be lighted by electricity. The poles, wires and lamps are all up and the power house is well under way.

The Kingston City Electric Railroad has been given permission to change the route of its lines through the city.

The Hudson River Telephone Company is stretching a new telephone line from Catskill to Albany by way of South Bethlehem.

The Elmira & Horseheads Railroad Company and the new West Side Company, after a long war, have reached an agreement by which the latter will cross the former's tracks.

The Poughkeepsie & Wappinger Falls Street Surface Railroad Company has been incorporated with a capital stock of $100,000. The length of the road is to be 10 miles.

A New Electric Road.—A number of local capitalists are considering the scheme of building an electric railroad with termini at Canandaigua and Palmyra. There is considerable interest in the project.

Extension of Time.—The time when the franchise granted to the Union Electric Light and Power Company, of Lansingburgh, shall become inoperative unless the company shall have begun the establishment of a plant has been extended six months.

An attempt was made to take the life of contractor Coffin by the Italians, at Johnstown, at work on the Cayadutta electric railroad. The mob was driven off before any one was injured severely. The trouble grew out of the failure of the men to receive their pay owing to the difficulty between the directors of the road and the contractors.

The Hudson River district of the telephone circuit has been divided into the northern and southern divisions. In the latter are Newburg, Haverstraw, Ellenville, Middletown, Port Jervis, Honesdale, Kingston, Fishkill and Catskill. Charles L. Quackenbush, of Kingston, has been appointed superintendent of the Newburgh district.

The Stillwater & Mechanicville Railroad will be operated by electricity. The majority of the stock of the road is held by D. Powers & Sons, bankers, of Lansingburgh, and with the other stockholders they have formed a new company, and application will soon be made to change the motive power. A belt line track to Mechanicville will be included.

The Lock City Street Railroad Company has elected the following officers: President, Wendell Goodwin; vice president, Charles Whitmore; treasurer, Frederick Swift; secretary, William Spaulding. The directors are: Frederick H. Reed, Wendell Goodwin, Charles Whitmore, Frederick Swift, S. Curt Lewis, John Hodge, S. Wright McCollum, E. M. Ashley, William Spaulding, W. T. Ransom, and G. N. McKibbon.

The Onondaga Electrical Company, a new concern, has established its office in Syracuse and the plans for its new building are being made. Some lively times are expected from its competition with the Syracuse Electric Light and Power Company. The old company's contract for lighting the streets expires within three years and the new company will make a fierce competition for the city contract. The old company, it is said, will endeavor to get a perpetual franchise.

The Citizens of Cortland are up in arms against a proposed increase in the telephone rate by the Empire State Telephone and Telegraph Company. Fully a hundred persons assembled at a mass meeting held recently. Mr. Henry L. Storke, president of the company, explained the reasons of the proposed increase. It was urged by the business men that there was a company willing to put in a system at the old rates. If the raise is made the telephones of a majority of the subscribers will be thrown out.

The obnoxious six-cent fare has been done away with on the Albany railway. The change to five cents was brought about by thousands of counterfeit tickets, remarkable fac-similes of the original, being circulated by parties as yet unknown. At a recent meeting of the company it was voted to reduce the tolls on the Albany-Troy road one half on all vehicles having tires four inches in width. Fifteen new cars have been received from the Gilbert Car Company. They have every known improvement. The furnishing and joiner work is of polished wood handsomely ornamented on the outside. The heating is done by electricity, there being four heaters in each car.

The Troy City Railroad has executed a mortgage for $2,000,000 and secures first consolidated five per cent. 50-year gold bonds It is dated Dec. 1, and runs from Oct. 1, 1892, to Oct. 1, 1942. The property of the Troy & Lansingburgh, Troy & Cohoes, and Waterford & Cohoes railroads, which is included in the combination is covered by the mortgage, which provides for the issuance of 2,000 bonds numbered from 1 to 2,000. Each bond will be of the value of $1,000. The mortgage was signed by President Charles Cleminshaw and Joseph J. Hagen on behalf of the Troy City Railroad Company, and President F. P. Olcott and Secretary C. H. P. Babcock on behalf of the trust company. It is in the form of a printed pamphlet that covers fifteen pages.

The report of the Troy & Lansingburgh Railroad Company for the quarter ending Sept. 30 shows the following:

	1891.	1892.
Gross earnings	$101 000	$112,838
Operating expenses	42.149	50,111
Net earnings	58,850	62,726
Other income	140	527
Gross income	58,990	63,254
Interest on funded debt	4,468	4,249
Taxes	2,040	2,144
Rentals	1,587	1,587
Net income	50,903	55,273
Cash on hand		31 762
Profit and loss (surplus)		307,575

The Cayadutta Electric Railroad will probably be running some time during January. The road will be equipped with 15 passenger cars. Four of them will have baggage and smoking compartments. There will be two electric engines for hauling freight, each with sufficient power to haul five of the largest freight cars up the hill. There will be two electric snow ploughs to keep the tracks clear in winter. The power house will be equipped with two Massillon engines, one of 300 and the other of 150 h. p., and three large steam boilers. The cars are being built by the Gilbert Car Company and will be unusually large and handsomely equipped. Work on this road, including the belt line in Gloversville, has been suspended on account of a misunderstanding regarding the contract between the company and H. Ward Leonard & Co., contractors. It is stated that the difference will soon be adjusted and the work resumed.

PHILADELPHIA NOTES.

Branch Office of The Electrical World,
Room 31, City Trust Building, 927 Chestnut St.,
Philadelphia, Pa., Jan. 7. 1893.

Mr. H. T. Paiste has gone to Chicago on a business trip.

W. T. Plummer, secretary and treasurer of the Main Belting Company, of Philadelphia, is sick and confined to his home.

Mr. H. J. Kenfield, of the *Street Railway Review*, of Chicago, called on The Electrical World Philadelphia branch office a few days since. Mr. Kenfield is on his way East making an extended trip in the interest of his paper, and does not expect to return before next March. Mr. Kenfield looks hale and hearty as usual, and reports business exceedingly good.

Dissolution of Partnership.—The partnership heretofore existing between Cunningham & Ambler, electricians and contractors, of Philadelphia, Pa., has recently been dissolved, Mr. Ambler retiring. The business will hereafter be conducted by Mr. John Cunningham, Jr., sole proprietor and owner. Mr. Cunningham reports business exceedingly brisk, and anticipates a continuation of the same for some time to come.

The Robinson Truck Company, of Altoona, Pa., has recently received the following orders: Ten standard trucks and 10 set of double trucks from San Francisco & San Mateo Street Railway Company, San Francisco, Cal.; a large order from the Citizens Street Railway Company, of McKeesport, Pa.; duplicate order from the Lansing Street Railway Company, Lansing, Mich.; also a large order from Atlanta, Ga. The Lamokin car bodies are mounted on most of the trucks mentioned in these orders.

PITTSBURGH NOTES.

Pittsburgh, Jan. 7, 1893.

The Citizens' Traction Company is making rapid headway with the completion of its new electric branch from the East End along Frankstown avenue to Wilkinsburg, and it is now almost positive that the line will be in operation by the first of February.

The Allegheny County Light Company has now completed its service of power current for small manufacturing plants in this city, and since the first day of the year the company has been giving its customers regular service from 6 A. M. until 7 P. M.

The West End Passenger Railway Company of this city, at the beginning of the new year, had all its cars on its new electric street railway equipped with electric heaters. The West End road is the only one in Pittsburgh which uses electric heaters exclusively on its line.

The Pittsburg Electric Club celebrated the advent of the new year in a very delightful manner. It will probably be remembered that on the first of January, 1892, the club opened for the first time the doors of its new club house, at 802 Penn avenue. In order to commemorate this event the club invited this year for the special occasion the members of the Pittsburg Press Club, and the combined members of these two organizations succeeded in making the evening very enjoyable. Singing, recitation, music and speeches were indulged in throughout the last hours of the old year, and Mr. Morris Mead, the president of the Electric Club, covered himself with glory as the host of the evening.

The Westinghouse Electric and Manufacturing Company Threatened.—A fire broke out in this city immediately opposite the works of the Westinghouse Electric and Manufacturing Company last night, and it would undoubtedly have done great damage to the electric works had it not been for the excellent organization of the Westinghouse fire department. This is a most important adjunct of the great Pittsburgh electric company, and like everything else about the establishment is attended to in the most perfect manner. On every floor of the company's works is at complete outfit of hose, buckets and other necessary appliances in case of fire. Owing to this arrangement and the perfect system of organization, it is now wellnigh impossible for a fire in the works to do much damage.

NEW ENGLAND NOTES.

Branch Office of The Electrical World,
Room 28, Hathaway Building, 620 Atlantic Ave.,
Boston, Mass., Jan. 7, 1893.

The Boston Metallic Packing Company, Portland, Me., was recently incorporated with a capital of $100,000 for the purpose of manufacturing metallic packing. R. C. Sweet, of Haverhill, Mass., is president of the company.

The New England Electric Club will hold its annual meeting in the club house, Bosworth street, Tuesday evening, Jan. 10 at 8 P. M. Officers for the ensuing year will be chosen and other business of importance presented. A collation will be served.

The Consolidated Electric Company's latest catalogue has just come to hand, and a very attractive whist counter. The latter is a novel way of advertising Bibber arc lamps and Lyon brake handles and dynamos, manufactured by the above company.

The Boston Heating Company will offer their entire equipment for sale at auction on Saturday, Jan. 21, 1893, at 10 o'clock A., M., on the premises, 464 Atlantic avenue. The sale will be a most important one, comprising boilers, engines, steam pumps fan blowers, dynamos, etc.

The Waterbury Brass Company, Waterbury, Conn., has erected several new buildings on the site of the old works, which were destroyed by fire some time ago. The two main buildings are of brick with iron roof. The frame of the building was constructed by the Berlin Iron Bridge Company.

The New England Engineering Company is the title of the new company which succeeds the Electric Railway Engineering Company. Mr. J. F. McGowan still continues as general manager, and A. W. Joastad as chief engineer. They will give their attention in the future to general construction work, as well as electrical engineering.

The Mather Electric Company, Manchester, Conn., have increased their manufacturing equipment by the addition of a frame building 200 by 50 feet, with iron roof, which will be furnished with all the latest and most improved machinery for general electric work. In addition they are erecting a blacksmith shop 20 by 30 feet. The shop is fitted with an overhead traveling crane, built by the Yale & Towne Manufacturing Company. The iron roof was constructed by the Berlin Iron Bridge Company, East Berlin, Conn.

The Elektron Manufacturing Company, of Springfield, Mass., is paying special attention at present to electric elevator business. It has installed within the last few months as many as fifty of these elevators, all of which are working satisfactorily. The hoisting apparatus is driven by direct gear, the movement of the car being controlled by the movement of the motor. The Elektron company claims that this arrangement is perfectly satisfactory and economical up to a speed of 550 feet a minute, and it will guarantee to install electric elevators to run at half the cost of those operated by water.

The National Telephone Manufacturing Company has had a man in Pennsylvania for the past five weeks installing telephone apparatus. One line at Du Bois has five stations upon it, nearly one mile between the terminals. A tannery service in same town has three stations. The company is now constructing a line of three stations for the Canonsburg Iron and Steel Company. From this place the men will go to Instanter, Pa., to construct a line of several stations at the tannery of Schultz & Hoyt. Correspondence is being had with the Cambria Iron Works, at Johnstown, also with other large corporations.

Haverhill's New Electric Works.—The new Haverhill electric plant was started up to-day. The buildings consist of two structures, the boiler room and the main building. The former is 60 × 45 feet inside and contains a battery of four boilers. The chimney, the highest in the city, is 125 feet and has a 7-foot flue. The engine room is 90 × 7 feet. Here are located two Harris compound engines, the larger developing 350 h. p., the smaller 250 Upstairs is located the dynamo room, which will contain eight machines, as follows: One Thomson-Houston alternating machine, having a 2,000-light capacity; another alternating machine of the Brush pattern, of 1,000-light capacity; one power machine of 100 h. p.; one Brush 45-light machine and four Thomson-Houston arc machines. The building itself is one of the best buildings in the State, if not the best, every piece of material having been carefully examined before being used.

New Street Railway.—Several weeks ago a petition for a charter to build an electric road between New Bedford and Fall River was presented to the Legislature, in which it was understood that many of the former stockholders of the Union Street Railway Company, who protested against the recent sale to the new syndicate, were interested. It was said that the true purpose of the company was to secure the privilege of running over the tracks of the Union Street Railway Company in this city and the Globe in Fall River. A company has now been organized composed of members of the syndicates owning the Union and Globe companies, which will be incorporated under the name of the Dartmouth & Westport Street Railway Companies. It proposes to build the road between the cities of New Bedford and Fall River, and hopes to secure the necessary privileges from the railroad commissioners before the first petition reaches the Legislature. The stockholders in the Dartmouth and Westport companies are J. A. Beauvais, A. P. Smith, Charles E. Cook, of New Bedford, and Frank W. Brightman, of Fall River, each owing 200 shares; James E. Dwight, New Bedford, 100 shares; Edw. S. Brown, New Bedford, 50 shares; Lot B. Bates, New Bedford, 37 shares; Edw. W. Bourne, Sylvanus T. Hawes, Stephen A. Brownell, John W. Macomber, James E. Dwight, Walter Clifford, John Duff, J. H. McKenzie, Simon Hawes, John A. Macomber, Charles Fisher and Henry A. Slocum, each one share.

WESTERN NOTES.

Branch Office of The Electrical World,
465 The Rookery, Chicago, Jan. 7, 1893.

The Long & Allstatter Company, of Hamilton, O., has recently had installed by the Central Thomson-Houston Company one multipolar generator of 100 k. w. capacity, together with all accessories for lighting its establishment.

The Chicago & Bedford Stone Company is now operating 60 h. p. of generators at its quarries at Bedford. The current is supplied to electric motors to operate hoists and to channellers and electric drills. The whole equipment was furnished by the Central Thomson-Houston Company.

The Central Thomson-Houston Company, of Cincinnati, has recently equipped the Cuyahoga Building, Cleveland, O., with two 25 k. w. multipolar and one 15 k. w. multipolar generators. These are direct connected and driven by Case engines. The Miami Powder Company's plant at Xenia, O., originally provided with 100 h. p. generating capacity, has increased its equipment and now has 1 m. p. 100 k. w. and 1 m. p 100 k. w. generator and additional motors, including one of 125 h. p. of multipolar type, and numerous smaller ones.

The Central Thomson-Houston Company, of Cincinnati, O., has recently taken orders for two 350 h. p. railway generators, and forty 25 h. p. railway motors for Columbus, O.; one 400 h. p. railway generator for Dayton, O.; two 750 h. p. generators and one hundred and twenty-five 15 h. p. railway motors for Louisville, Ky. The same company is equipping a central lighting station at Louisville with 2,000 h. p. of engines and generating capacity for 15,000 incandescent and 500 arc lights and 500 h. p. of stationary motors.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, Dec. 7, 1892.

City Lighting.—Our London gas colossus, the Gas, Light and Coke Company, has, to use a colloquialism, "cut up rough." At the last meeting of the City Commissioners of Sewers the engineer reported that he had applied to the gas company with regard to utilizing existing lamp posts in the side streets for incandescent lamps in such a way that if the electric light should fail gas could be made use of. In reply the gas company said that they were of the opinion that the Commissioners would recognize the fact that the gas company had done all in its power to facilitate the improved lighting of the streets, even at considerable cost to itself, notwithstanding this the electric light had been adopted, the company, therefore, could not allow their fittings to be made use of as suggested.

City & South London Railway.—This company has at last given notice to the local authorities concerned of its intention to make use of the Parliamentary powers which it has long possessed and to carry out its southern extension to Clapham Common. This extension to the south, although not more than a mile in length, is likely to make a considerable addition to the value of the company's property, since the line will then terminate at a definite point to and from which there is considerable traffic. No doubt the company's extension of three or four miles to the north, for which Parliamentary powers will certainly be obtained early next year, will be carried out at the same time as the Clapham extension. This company's receipts continue to increase in the most satisfactory manner, but ever and anon complaints appear in the newspapers of the crowding of the cars.

Municipal Authorities and the Overhead Trolley System.—Mr. Graff Baker having recently endeavored to persuade the Coventry Town Council to allow him to introduce the overhead trolley system of electric traction into that town, a committee was appointed to consider the proposal and a deputation of this committee recently visited the South Staffordshire lines and Mr. Graff Baker's line at Leeds. The committee has much to say with regard to the various advantages of electric traction, but are of opinion that poles and overhead wires would be such an obstruction and would so disfigure the streets of Coventry, that they strongly advise that consent be refused to the introduction of such a system under any circumstances whatsoever. The report goes on to say that Mr. Graff Baker has stated his readiness to do everything possible to remedy the obstructiveness and unsightliness of his system. The committee however remain of the opinion that the poles and wires would in any circumstances be unsatisfactory.

Lamp Renewals.—Contrary to the custom which usually obtains on your side of the water, no English electricity supply company, certainly none of any standing, undertakes lamp renewals. A curious decision has, however, been rendered within the last day or two, by a County Court judge at Ipswich. Messrs. Lawrence & Scott carry on business there, and one of their customers demanded to be recouped for money spent on lamp renewals, and judgment was given against the company on the ground that the supply of incandescent lamps was as much a part of the contract as the supply of current. I do not know the terms of the agreement entered into by Messrs. Lawrence & Scott, but if they supply electricity under a provisional order, this decision is certainly erroneous. I do not know of any mention of the words "electric light" in the body of a provisional order. All that the companies are bound to do is to maintain a constant supply of *electric energy* at proper pressure.

The Amalgamation of the National and New Telephone Companies.—The New Telephone Company, which ever since its revivification a few months back has been virtually, though not nominally, an off-shoot of the National Telephone Company, has now publicly and formally amalgamated with it, each shareholder in the new company being offered a £5 fully paid share of the National company in return for his £10, £4 paid, share in the New company. This step, whatever may be the good or evil result to the public (quite a secondary matter no doubt in the eyes of the directors of the telephone colossus), will render government purchase a more simple, though very possibly a decidedly more costly process. It may be interesting to mention that the authorized share capital of the National Telephone Company is £4,000,000, of which about £3,200,000 has been issued and paid up, there being in addition about £725,000 of debenture stock. Of the unissued share capital, amounting to about £300,000, something like £250,000 will be required to purchase the New Telephone Company.

Earthing the Middle Wire.—The controversy which has been raging on your side of the Atlantic of late with regard to "earthing" the middle wire now threatens to arise in this country, a recent fire in a Regent street shop front being the disturbing cause. The circuit which apparently caused the mischief was an incandescent lamp circuit, and was, it appears, switched off, but owing to there being an earth on one of the main wires, and also on the lamp circuit, an earth circuit was established, which resulted in a blaze. It is evident, therefore, that with the present system of insulation we must make profuse use of double pole fuses and switches, or we must earth the middle wire. Mr. Heaphy of the Phœnix fire office, who is responsible for the widely known Phœnix rules, has been up to the present dead against concentric wiring with outer sheating to earth, and the "earthing" of the middle wire of a three-wire system. Now, however, that Mr. Human of the Guardian fire office has shown how advantageous these devices would be, it is to be hoped that Mr. Heaphy will withdraw his opposition.

Electrical Manufacturing Finance.—It has long been known to those behind the scenes that in spite of the outward prosperity of the electrical manufacturing business in this country there was considerable danger ahead, owing to the vicious custom brought about by over competition of accepting shares in lieu of hard cash in return for work done. The results of this way of going to work are at last coming home to roost. The well-known electrical manufacturing concern, the Electric Construction Corporation, of Wolverhampton, has within the last few days been obliged to seek the assistance of an electrical financing company called the Electric and General Investment Company, for the purpose of guaranteeing one-half of a proposed issue of £100,000 second mortgage bonds. Still more recently the widely known firm of Woodhouse and Rawson have issued a report, which has been as far as possible kept from the knowledge of the press, in which a loss of £37,000 on the year's working is confessed to; in addition to heavy dippings into the reserve fund. It is to be hoped that these disclosures will bring about a more healthy mode of conducting business.

National Telephone Company vs. Graft Baker.—A sensible proposal made by the judge with a view of shortening the duration of this action was acceded to by both parties before the rising of the court on Wednesday evening last. As is almost invariably the case in these actions, exactly similar tests made by experts engaged to back up different points of view have given totally dissimilar results. An important point for the telephone company is to prove that the working of Mr. Graff Baker's electric tramway renders the telephone useless for all practical purposes. Contrariwise, it is important that Mr. Graff Baker's side should show that the disturbance is one that people easily get accustomed to. Lord Kelvin and Dr. John Hopkinson, on behalf of the plaintiffs, were emphatic in testifying that the disturbances were in many cases such as to prevent the every day use of the telephone. On the other hand, Mr. James Swinburne and M. Abdank Abakanowicz were ready to swear that the buzzing, etc., was no worse than the London telephone subscriber is wont to put up with almost every day of his life. To get at the *facts* an independent expert, named by the judge and accepted by both parties to the action, is going down to Leeds during the recess to make a report to the court. On Wednesday afternoon Mr. W. H. Preece gave evidence, which I think cannot but have a most important influence upon the result of the case. He was most emphatic, and what is perhaps still more important, most lucid in his advocacy of the twin wire system of telephony, and although submitted to a somewhat severe cross examination by Sir Richard Webster, with a view of showing that his (Mr. Preece's) experience was comparatively limited, and that the failure of the Post Office to compete with the National company was connected with the adoption by the government of the complete metallic circuit, his testimony was not shaken in the slightest. Mr. Preece pointed out that altogether apart from reason of departmental policy into which he could not enter, the comparatively poor success of the Post-Office telephone exchanges was entirely due to the fact that first, a government department could not "tout" like an ordinary commercial concern, and, secondly, that the Post Office charged for its undoubtedly superior service a somewhat higher rental, which the average English subscriber was apparently not prepared to pay.

News of the Week.

THE ELECTRIC LIGHT.

Leipsic, O., contemplates the installation of an arc light system.

Stanhope and Port Morris, N. J., are considering the erection of an electric light plant.

The Le Mars (Ia.) electric light plant is illustrated and described in the holiday edition of *Le Mars Globe*. The plant is a first-class one in every respect and the citizens of Le Mars are justly proud of it.

Fergus Falls, Minn.—Arrangements are being made to put in an electric plant in the spring. In order to secure power for it the sixth dam will be constructed across the Red River. This power is about a mile below the centre of the city.

The Detroit Motor Company, of Detroit, Mich., has just installed a model isolated electric plant in the Pingree & Smith shoe building at Detroit, consisting of two 40-k. w. incandescent dynamos of 1,300-light capacity. These machines are located in the engine room on a platform 12 feet high, underneath which is placed a highly finished marble switchboard 8 by 4 feet, inclosed in an oak finished cabinet, so arranged that any of the six floors can be separately lighted and other combinations made. It is also provided that Edison current from the ordinary mains can be used. The plant is wired with combination wire and strung upon porcelain cleats throughout.

The Fort Street Union Depot, Detroit, Mich., will be completed by Jan. 15. It is a handsome brick building covering a space of one-half a square in which the Western Electric Company, of Chicago, has installed one of its complete isolated plants, consisting of two 26-k. w. dynamos supplying 800 incandescent lamps and one 40-arc light dynamo of the new Western type D. These are run by two 65-h. p. Ideal engines. The baggage and express room are wired for arc lights from the incandescent circuits. There are no soldered or tape joints and interior conduits are used throughout as well as New York Safety wire. The marble switchboard, 6 × 7 feet, is mounted with necessary apparatus of the Western Electric Company's make. The installation was superintended by Mr Frank B. Rae.

THE ELECTRIC RAILWAY.

The Hammond (Ind.) company's plant has been purchased by the Hammond Street Railway Company.

St. Paul, Minn., has passed an ordinance limiting the rate of speed of street railways within the city to eight miles an hour.

Fifty Thousand Dollars a Foot.—Henry Peyser has brought suit against the Coney Island & Brooklyn Railroad for $100,000 damages for the loss of both feet as the result of an accident on Decoration Day, 1891.

The Steinway system of street railways running from Long Island City to Astoria has been sold to R. P. McCabe, Benjamin Orne and Gardner Van Ostrand, of New York City. Electricity will be substituted for horses as a motive power.

An Electric Tramway System in Bangkok, Siam.—The *Bangkok Times* of Nov. 12 notes the arrival of Mr. W. J. Davison, of the Short Electric Railway Company, of Cleveland, O., who has gone out to that country to superintend the erection of a plant for the Bangkok Tramways Company.

The electric railroad which is being constructed between Chippewa and Queenston, Canada, along the Niagara River, is fast nearing completion, and it will probably be in operation in May. The cars are being constructed at St. Catherines by Patterson & Corbin. P. Cook & Sons, lumber merchants at St. Catherines, have purchased the 150-h. p. generator that did service for the "Mimico," and contemplate supplying power to the city.

Proposed Consolidation and Extension of Railway Lines in Maine.—It is reported that all the electric railway and electric light companies in Maine are to be consolidated into one company with a capital stock of between $4,000,000 and $5,000,000. A. T. Gerald is the prime mover of the project. It is stated that the company will ask the next legislature for a charter to buy a lease to build and operate street railways, light, heat and power companies throughout the State.

The Doylestown, Dublin & Perkasie Electric Railway will probably materialize shortly. The capital stock is to be placed at $150,000 at $25 per share. The road will run if constructed from Doylestown, Pa., to Perkasie, a distance of 12 miles. Meetings have been held in both places in the interest of the enterprise, and the Doylestown Electric Company is thoroughly investigating the matter. The water power of the Delaware River, some nine miles distant, may be used. This company has recently added a 45-k. w. alternating machine and a 100-h. p. engine to its plant.

The Consolidated Street Railway Company, of Syracuse, N. Y., held a meeting on Jan. 3 at which the following gentlemen, representing the syndicate which recently purchased both the Consolidated and People's companies, were elected to the board of directors: C. L. Stone, G. B. Leonard and P. T. Brady, of Syracuse; H. C. Ford and G. E. Herrick, of Cleveland, O.; W. R. Kimba Cincinnati, and T. H. Conderman, of Philadelphia. The new directors chose as president W. W. Hazard; vice-president, P. T. Brady; secretary, W. P. Gannon, and treasurer, W. R. Kimball. Mr. Paul T. Brady is the representative of the General Electric Company at Syracuse, but it is positively denied that that company is interested in the purchase; it is probable, however, that the system will be equipped with Thomson-Houston apparatus.

PERSONALS.

Obituary.—The death of Mr. Henry H. Crocker, the father of Prof. Francis B. Crocker, occurred at his residence in New York City on the 5th inst. The funeral took place on Sunday at All Souls' Church.

Mr. W. Barstow, of the Brooklyn Edison Electric Light Company, sailed on the Britannic of the White Star line, on Wednesday morning, for London and Paris, where he will investigate the electric light plants of those cities in the interest of his company. His associates presented him with a handsome floral piece in the form of an incandescent lamp.

LEGAL NOTES.

Liability for Defective Insulation.—A passenger, while passing from the motor to the trailer of an electric street railway train by swinging from the step of one to the other, grasping the iron handles on the dashboards between them, was injured by receiving an electrical shock, the handles being charged with electricity which had escaped as the result of improper insulation of the wires conducting the motive power. The company having the means of readily ascertaining whether electricity was escaping, it was chargeable with notice that its apparatus was in a defective condition, and that, in such event, the iron handles would become charged. It being the custom of passengers and conductors thus to pass from one car to another while they were in motion, and there being no rule against it, and no reason to apprehend a current of electricity, so doing cannot, as a matter of law, be held contributory negligence.—(Burt v. Douglass County Street Railway Company, Supreme Court of Wisconsin, 53 N. W. Rep., 147).

The Attorney General has begun proceedings against the Metropolitan Railroad Company, of Washington, D. C., to annul its charter. This action has resulted from the failure of the railroad company to pave the space between, and two feet beyond, each of the outer rails as prescribed by its charter and which was done during the years 1871-5, at the expense of the District. In November, 1880, the District government brought an action in the Supreme Court of the District to recover $161,62.50 for work done and material furnished in doing the necessary paving, and in May, 1884, a judgment was rendered in its favor, amounting to $147,450.05. The railroad company then carried the case to the Supreme Court of the United States, when the decision was reversed upon the sole ground that the action in which the judgment was recovered was barred by the statute of limitations before the institution thereof. On March 3, 1891, the President approved an act which enacted among other things, as follows: "And the Metropolitan Railroad Company of the District of Columbia, shall pay to the District of Columbia within eighteen months from the approval of this act the full amount of the judgment that was rendered against said company by the Supreme Court of the District of Columbia at the suit of said District . . . with costs of said cause, and interest on said amount from the date that said judgment was rendered until paid, and that upon the failure of said company so to pay said amount, costs and interest within the time aforesaid, the charter of said company shall become forfeited, and all its rights, privileges and franchises as a body corporate shall cease and determine."

MISCELLANEOUS NOTES.

Electricity as a Motive Power for Canal Boats.—At a public meeting held at Kingston Hall, 10 South street, New York City, to protect the terminals of the Erie canal, resolutions were adopted indorsing Governor Flower's recommendation that electricity be used as a motive power on the canals of the State.

The Fort Wayne Electric Company.—Mr. Brainard Rorison writes us that the damage recently done to the Fort Wayne Electric Company's works is being rapidly repaired, and that all departments will be running again by the time of the next issue of THE ELECTRICAL WORLD.

The Children are Catching On.—The Shultz Belting Company, of St. Louis, Mo., had an exhibit and manufactured belting at the St. Louis Exposition, and the following incident is the result of a visit to that institution by one of the pupils of the Divoll School: A few days ago a teacher in the Divoll Kindergarten was giving her pupils a little instruction in astronomy and the movements of the planets in the solar system, and said to a little boy: "Johnnie, what causes the earth and moon to spin on their axes like a top, as they do?" "That there strap," answered Johnnie. "What strap; what do you mean?" inquired the mystified teacher. "Why," said Johnnie, "I see on one of the picture cards, down at the Exposition, of that company what had that machine what chops pieces of leather up into little squares, a picture of a strap running around the earth and moon, making them spin around like a top."

Industrial and Trade Notes.

Messrs. James Schawel & Co., of 29 John street, New York City, report active sales of their flat sheet wire and coil platinum in all sizes.

The McCreary Specialty Company, 136 Liberty street, New York City, has issued a new calendar for 1893 to replace the old one in its glass paper weight.

The Phosphor-Bronze Smelting Company, Limited, 512 Arch street, Philadelphia, Pa., is sending out a very prettily designed calendar to its many friends.

The Eureka Packing Company has received an order for 50,000 pounds of "Eureka" packing, which is believed to be the largest single order ever placed with a manufacturer.

The Standard Underground Cable Company, of Pittsburgh, has issued a four-page, neatly printed leaflet, setting forth in a concise manner its specialties in wires and cables.

The Union Telephone and Electric Manufacturing Company, New York City, is meeting with success in the installation of electric lights, bells, telephones and other appliances.

The Bubier Publishing Company, Lynn, Mass., has sent us a calendar containing 12 sheets neatly bound together, upon each of which is a handsome engraving of one of the World's Fair buildings and a calendar for a single month.

The Largest Belt in the World.—The Shultz Belting Company, of St. Louis, has just received from Cleveland, O., an order for a Shultz Patent Sable Rawhide belt 80 inches wide. This will be the largest belt ever manufactured.

W. R. Brixey reports large increase in sales of Kerite wire, underground, aerial and submarine cables for year ending Dec. 31, 1892. Further appreciation of the fine quality of goods of his manufacture is shown by the large number of advance orders on hand

Magie Brothers, dealers in lubricating oils, 409-411 South Canal street, Chicago, Ill., have sent us a neatly designed calender which will remind every one who sees it of the "Rock Brand" oils which have found very extensive use for lubricating cylinders, engine bearings, dynamo bearings, etc.

The Southern New England Telephone Company, of which Mr. Ellis B. Baker is general superintendent, has furnished its patrons a neat map of its long distance lines in the State of Connecticut and southern Massachusetts, to which, for the convenience of its patrons, the company has attached a useful calendar for the coming year.

The Central Electric Company, of Chicago, Ill., has sent out a calendar similar in design to the one supplied a year ago. It seems to have been so satisfactory that the company has deemed it wise not to change the design. A very elaborate engraving at the top of this calendar shows the various lines of electrical supplies in which the company deals. These supplies cover every conceivable line of electrical application.

Mr. Avery P. Eckert, representing Day's kerite wires and cables, left Monday last on an extended business trip west, and will also visit the principal business centres of the far south. Mr. Eckert expects to be absent some three months, and hopes to greet his many friends at the National Electric Light Association's annual convention at St. Louis next month.

The American Electrical Works, Providence, R. I., have in accordance with their usual good taste, gotten out a novel design in a calendar for the coming year. It is ornamented with a lithograph representation of the signs of the zodiac, together with a reminder that the company sending it out is ready to supply wire for railway, lighting and other purposes.

Waterhouse, Gamble & Co.'s arc lamps are meeting with good success. The description which was published in a recent number of The Electrical World might be interpreted by some to mean that the lamps were still in an experimental state. Such, however, is not the case, as they are thoroughly standardized and are in actual use in many places, giving the greatest of satisfaction.

Alfred F. Moore, 200-202 North Third street, Philadelphia, Pa., has eclipsed all his rivals in the proportions of calendar which he has selected to send to his patrons. It is admirably fitted for office use and wherever placed will be a constant reminder that Mr. Moore is ready to furnish insulated electric wires and cables manufactured by him either for electric light, power, telephone or telegraph purposes.

The Pennsylvania Electric Engineering Company, of the Penn Mutual Building, Philadelphia, has signalized the new year by sending out to its patrons and others a calendar ornamented by a very beautiful engraving intended to remind those who use it for reference during the year of the fact that there is no lamp like the "Pennsylvania." This company, as our readers know, supplies Western Arc and National Incandescent apparatus.

Albert Frank & Co. is the firm name of the successors to Frank, Kiernan & Co., the copartnership of the latter company having expired on Dec. 31 by limitation. Mr. John J. Kiernan has ceased from that date to be a member of the firm by mutual consent. The new firm, which is composed of Messrs. Albert Frank and James Rascovar, has assumed all firm liabilities, and will continue the business of general advertising agents at 142 Broadway, New York City.

Queen & Company, Incorporated.—Among recent business changes of special interest to the electrical fraternity is the transferring of the business of James W. Queen & Co., Philadelphia, to a stock corporation bearing the title Queen & Co., Incorporated. The new company starts with a paid-up capital of $600,000, which will be increased from time to time as may be required for the extension of its numerous interests, which in addition to electrical measuring instruments comprise scientific apparatus of every description. The incorporators and directors for 1893 are: S. L. Fox, E. B. Fox, J. G. Gray, W. Biddle, Jr., J. G. Biddle and F. W. Stanwood, all of whom have been actively connected with the old firm. E. G. Willyoung continues as superintendent of the electrical laboratory.

Business Notices.

Transformers rewound and repaired. Write for prices. The Hill Manufacturing Company, Salem, Va.

Oil Filter for sale cheap; send for prices to Purity Oil Filter Manufacturing Company, 901 Water street, Pittsburgh, Pa.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

[In Charge of W. A. Rosenbaum, 177 Times Bldg., N. Y.]

UNITED STATES PATENTS ISSUED JAN. 3, 1893.

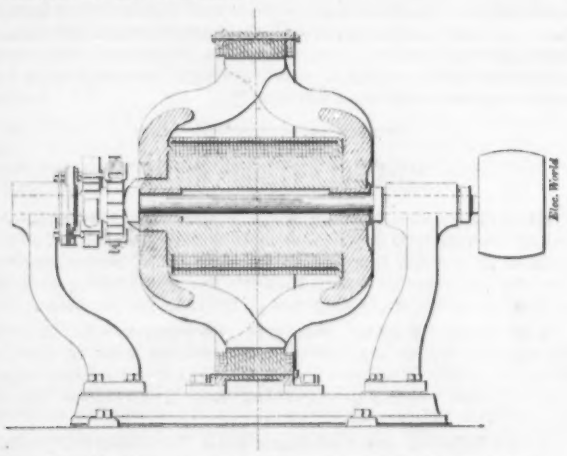
22,101. Design for a Case for Electrical Measuring Instruments; Edward Weston, Newark, N. J. Application filed Dec. 7, 1892. This invention consists of a case rounded in front, with parallel sides; above this lower and parallel portion is a cylindrical portion. The top is flat, or nearly so. Above this upper surface is a sector shaped portion.

488,978. Brush Holder for Dynamos and Electric Motors; Ralph Ashley, Philadelphia, Pa. Application filed Feb. 18, 1892. The combination of the brush, the brush holder or receiver, a follower, and spring-actuated feed wheel adapted to feed the follower and brush against the commutator.

488,993. Telephone Switch; John Chisholm Francis, New York, N. Y. Application filed Feb. 15, 1892. A telephone switch comprising a rotatable hook for supporting the telephone having a shaft rotating therewith in the plane of the hook, a commutator mounted on the shaft, and brushes bearing on the commutator.

489,000. Commutator for Dynamos and Electric Motors; Henry G. Groswith and Ralph Ashley, Philadelphia, Pa. Application filed Feb. 18, 1892. In disc commutators, the circular disc or backing-plate having an undercut projecting hub bored through around its central aperture to receive bolts for its attachment to the armature core, and provided with a screw-threaded flanged rim and radial reinforcing-ribs.

489,005. Elevator Indicator; Nelson Hiss, Baltimore, Md. Application filed March 24, 1892. In an electrical indicator for elevators, the combination with the casing of a shaft journaled therein, an indicating disc or plate on the shaft, a pinion, a rack-bar pivoted to the casing, a rack on the rack-bar engaging the said pinion, an armature on the rack-bar, and a magnet in the casing above the armature.



No. 489,065.—Alternating Current Dynamo.

489,046. Electric Arc Lamp; Elihu Thomson, Swampscott Mass. Application filed Feb. 4, 1892. In an electric arc lamp, the combination with the carbon and the feeding mechanism therefor, of a cut-out device connected to one of such parts and responsive to difference in movement between them, due to stoppage of the carbon holder, and operating to cut out a part or whole of the lamp.

489,065. Alternating Current Dynamo; James J. Wood, Fort Wayne, Ind. Application filed July 22, 1892. The combination of a revolving multipolar field magnet with a stationary ring armature within which it rotates, said armature consisting of an annular core much narrower than the field magnet, and successive coils applied to said core, and said field magnet consisting of an axial core, and exciting coil around said core, and alternated polar arms radiating from the opposite ends of said core, bending back around said coil to the middle of the core, and having their end positions turned outwardly and terminating in poles facing and closely adjacent to said armature.

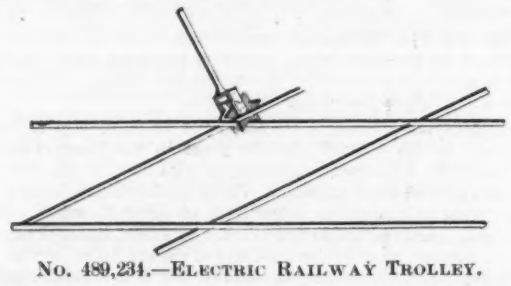
489,070. Armature for Electric Motors or Dynamos; Cornelius F. Daniels, Macon, Ga. Application filed Dec. 2, 1891. In an electric motor or dynamo, an armature composed of separate bobbins wound with wire, each bobbin having a separate core, said bobbins surrounding the armature axis and secured thereto by end pieces and by wedge-shaped clamping pieces between the outer portions of the bobbins.

489,071. Field Magnet for Electric Motors or Dynamos; Cornelius F. Daniels, Macon, Ga. Application filed Dec. 2, 1891. A field magnet for electric motors or dynamos consisting of two or more pieces of iron bolted or fastened together, said pieces being hollowed out to form cores, wire wound round each of said cores, and wire wound around the outside of said wire wound cores.

489,075. Thermometric Indicator; C. R. H. Erkens, Lakewood, N. Y. Application filed Sept. 15, 1892. In a thermometric indicator, the combination of a thermometer tube, electric alarm circuit wires terminating in electrode ends within said thermometer tube and out of contact with each other, the mercury in said tube adapted to close the circuit between the wire terminals when it rises to a given point, and supplemental circuit closing devices adapted to be lowered onto the wire terminals by the fall of the mercury and to close the circuit there between independently of the mercury when it has fallen to a given degree.

489,097. Trolley Wire Support; George H. Scranton and Lorenz Spillman, Columbus, O. Application filed May 27, 1892. In a device for supporting trolley wires from a suspension wire, a bar or plate having a rounded lower side, and bracket arm rising from and overhanging said bar.

489,098. Testing Apparatus for Multiple Switchboards; Charles E. Scribner, Chicago, Ill. Application filed June 19, 1888. The combination with telephone lines each connected through a spring-jack on each of two or more boards and directly to ground, of a branch or test wire connecting each line with the testpiece or insulated frame of each of its switches, and testing apparatus consisting of a circuit including a test plug, having a single contact, a battery and an indicator proportioned with respect to electromotive force and ampere turns; whereby it may be determined at one board whether or not any given line is connected or in use at any other of the boards.



No. 489,234.—Electric Railway Trolley.

489,099. Testing Apparatus for Multiple Switchboards; Charles E. Scribner, Chicago, Ill. Application filed June 19, 1888. The combination with a telephone extending through a series of switches, of a current generator connected with said line for sending an undulatory, direct or alternating current of low electromotive force upon said line; a test circuit including a telephone and rheotome and a circuit changing device for alternately connecting said test circuit with different sides of said generator; whereby on closing said test circuit with any spring-jack switch of the series the operator listening at the telephone may make a test to determine whether the line is in use.

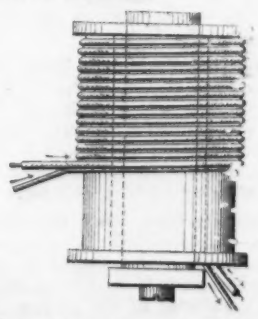
489,100. Test-Circuit for Multiple Switchboards; Chas. E. Scribner, Chicago, Ill. The invention consists in providing a retardation coil in a ground branch connected with a test battery for each of the telephone lines, in combination with a cord switch and listening and calling key and the operator's telephone and switching devices so arranged that the operator on raising the plug in response to a subscriber's call brings her telephone into circuit and throws on the branch containing the retardation coil and battery to make the line immediately test busy.

489,113. Operating Device for Bridge-Gates; Edward Zaremba, Chicago, Ill. Application filed March 5, 1892. The combination with a turn bridge and its approaches, of a gate or gates guarding each approach, motors for operating said gates, a switch upon the bridge for controlling the electric currents whereby the motors are set in operation, an electric generator and electrical connections between the switch and motors.

489,114. Electric Metal-Working; Craig R. Arnold, Sharon Hill, Pa. Application filed May 17, 1892. The improvement in metal-working by the electric arc, consisting in setting up an extra or induced current in the circuit of the arc.

489,115. Secondary Battery; Craig R. Arnold, Sharon Hill, Pa. Application filed May 21, 1892. In a secondary battery, an electrode consisting of a number of superposed plates of lead having interposed between them lead shot and all clamped together.

489,158. Incandescent Lamp-Socket; George C. H. Foster, Bridgeport, Conn. Application filed Feb. 8, 1892. In a socket for incandescent lights, a controller block stamped out of sheet metal and bent up into form consisting of a central body having four equidistant wings extending radially therefrom in combination with a resilient knuckle adapted to co-operate with said wings to lock the block in position.



No. 489,277.—Electro Magnet.

489,161. Electric Meter; Heinrich Illig, Bockenheim, Germany. Application filed Jan. 7, 1892. An electric meter, composed of a solenoid located in the main circuit, a current-indicator actuated by the core of the solenoid, a weight suspended from the core, an oscillating lever, an electro-magnet for operating said lever, a clock-train for controlling the current of said magnet, a curved guide strip for the weight, a registering device, and transmitting mechanism between the oscillating lever and the registering device.

489,185. Commutator-Brush Holder; Charles F. Goodrich, Chicago, Ill. Application filed Dec. 29, 1891. A commutator-brush holder comprising a guide for the brush cast in one piece, with a housing and attaching shank, a spring controlled pressure mechanism in opposition to the brush, and suitable means for regulating the tension of said pressure mechanism.

489,186. Storage Battery Electrode; George W. Harris, New York, N. Y. Application filed April 14, 1892. The method of constructing a storage battery electrode consisting in building it up from alternate strips or sheets of conducting and absorbent non-conducting material, each alternate sheet of conducting material extending laterally over the opposite edges of the intermediate absorbent material, and finally uniting the extending edges together in each instance in one integral face or mass.

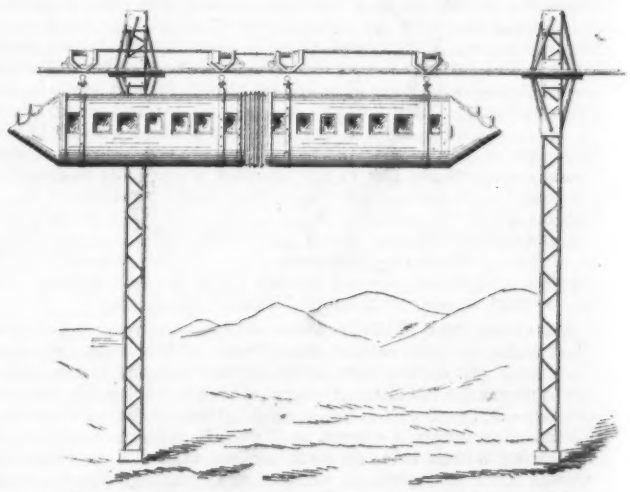
489,216. Amalgamator; Hugh Calhoun, of Hot Springs, Ark., and Aron M. Beam, Bear, Ark. Application filed June 30, 1891. In combination with an amalgamating vessel, an electric generator connected therewith and adapted to deliver an interrupted current of constant direction.

489,234. Electric Railway Trolley; Jean Reutlinger, St. Louis, Mo. Application filed July 30, 1892. A trolley having tee h arranged on the sides of the same and insulated from the body portion thereof.

489,237. Fire Alarm; William J. Schweiger, New York, N. Y. Application filed July 11, 1892. In an electric alarm system an alarm bell for the several compartments, inclosed in a casing concealed in a wall, and having a door adapted to open on an electrical alarm and display printed instructions for escaping, the said casing having an electric light lamp arranged therein and capable of being lighted simultaneously with the opening of the door.

489,249. Electrical Measuring Instrument; Johannes Heinrich Friederich Gorges, Berlin, Germany. Application filed Oct. 27, 1892. In an electrical measuring instrument, the combination of a conductor, a portion of magnetic material attached thereto, having a semi-circular cavity in one end thereof, an armature mounted upon a shaft and adapted to move concentrically with the inner surface of the cavity, when influenced by a current transmitted through the conductor, a scale, and an index pointer to which motion is transmitted from the armature

489,266. Telephonic Switch Appliance; Farnell Rabbidge, New South Wales. Application filed Jan. 2, 1892. In combination with a reversible vessel, insulated end plugs, a set of contacts extending through the plugs into the vessel, mercury within the vessel, contacts and an electrical connection between them.



No. 489,330.—Electric Elevated Railway.

489,277. Electro-Magnet; Richard Varley, Jr., Englewood, N. J. Application filed June 13, 1892. The combination in an electro-magnet of the helix composed of two parallel wound wires, one being covered and the other uncovered, and one layer of wire insulated from the next layer of wire.

489,302. Dynamo-Electric Machine and Motor; Walter T. Goolden and Llewellyn B. Atkinson, London, England. Application filed Aug. 18, 1891. In combination, the armature, the commutator, and brushes therefor, the airtight non-magnetic casing surrounding the armature, and a jointed supplemental portion of the casing surrounding the commutator and the brushes, and carrying the bearings, whereby access to said commutators may be had without removing the main casing.

489,312. Fire or Burglar Alarm; Eleazer La France, Worcester, Mass. Application filed June 7, 1892. A fire and burglar alarm, comprising a supporting block having a band thereon, which forms one terminal of an electric circuit which includes an electric alarm, a plurality of springs secured to the block and forming the other circuit terminal, said springs being arranged to contact with the band, and outwardly extending springs secured to the free ends of the springs and adapted to be attached to a support.

489,315. Secondary Battery Electrode; Auguste Marie Michel, Paris, France. Application filed Aug. 24, 1892. In a lead-zinc accumulator, a negative element consisting of the combination with a frame, core or other suitable support, or an amalgam rich in mercury (that is to say in which the quantity of mercury equals or exceeds that of the other metal) securely held therein.

489,316. Manufacture of Accumulator Plates; Auguste Marie Michel, Paris, France. Application filed Aug. 24, 1892. The process of making active material for electric accumulators, by forming an alloy of lead and other metal, such as zinc, disintegrating or reducing the alloy, eliminating the metal alloyed with the lead and leaving the latter in a porous, distended condition, and finally compressing the lead into the desired form.

489,330. Electric Elevated Railway; Andrew L. Rutter, Washington, D. C. Application filed Feb. 20, 1892. In an elevated railway system, the combination with motors and an elastic device which couples them, of cars suspended from these motors and an elastic "vestibule" connected between them.